



**Development and Feasibility Testing of a Web-based Self-Management
Intervention for Nurses with Low Back Pain: A Mixed Method Study**

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Abstract

Background: Low back pain (LBP) is known to be a major occupational hazard among healthcare workers which can lead to a significant health and economic burden. Globally nurses have a higher prevalence of LBP compared to other occupations, thus resulting in decreased job productivity, higher rates of absenteeism, disability and functional limitation. In the Kingdom of Saudi Arabia (KSA), similar findings in a number of studies have indicated a high prevalence of LBP prevalence which correlates with statistical data in other countries. This makes the prevention of and intervention strategies for the management of LBP among the nursing profession a key priority. The use of digital technology as an intervention is considered an innovative strategy for approaching behavioural self-management for patients with LBP, and to provide clinically significant effects in self-reported outcome measures of pain intensity, disability, quality of life and physical activity (PA) that can subsequently have a positive impact on those afflicted with this condition thereby enhancing levels of patient care for their organisations respectively.

Objectives: The primary objective of this study is to test the feasibility and acceptability of the web-based intervention programme for self- management of LBP (WBI-BACK) among the nursing population in the KSA. The secondary objectives were to identify potential changes in outcome measures to assess the delivery of the WBI-BACK programme to nurses in a future clinical trial.

Methods: This study employed a convergent parallel mixed method research (MMR) design, which was based on a feasibility study design. The participants were recruited from the King Fahd Medical City (KFMC) Rehabilitation Hospital based in Riyadh; KSA. The primary outcomes of the definitive planned study were descriptive and used to evaluate the feasibility of the study design including recruitment rate, attrition rate, feasibility of outcome measures, intervention adherence and experiences of the intervention components. Secondary outcomes

involve exploratory analysis of LBP-related measures including PA, fear-avoidance beliefs, pain intensity, physical functioning, quality of life and self-efficacy. Quantitative data was conducted by two groups (an LBP group and NO LBP group) pre- and post- intervention through primary and secondary outcomes at baseline and 6 weeks after the WBI-BACK intervention. Qualitative data was collected through semi-structured interviews.

Results: Fifty-three nurses (35 nurses - LBP group; 18 nurses - NO LBP group) were recruited. The findings from quantitative data indicated the feasibility of the primary outcomes. Nurses in both groups improved in their secondary outcome measures after the WBI-BACK intervention. Thematic analysis of the interview data from 16 nurses revealed four themes (nurses' perception of usability of the WBI-BACK programme, nurses' perception on potential WBI-BACK programme usefulness, nurses' engagement with the WBI-BACK programme and nurses' attitude towards the WBI-BACK programme) relating to the necessary features required of the WBI-BACK programme to enable its successful use with the nurses. Following quantitative and qualitative data analysis, data were assessed against a priori defined feasibility success criteria. The results indicated the feasibility of the research process and the data collection; three out of five a priori feasibility criteria were met (recruitment rate, attrition rate and experience of the intervention), while the last two (intervention adherence and feasibility of outcome measures) were met with some modification.

Conclusion: The WBI-BACK programme is currently being evaluated in a feasibility trial. Based on the results of this study, it can be inferred that the WBI-BACK programme is feasible and can be used for nurses in the KSA with LBP. This thesis proposes exciting opportunities of future research, involving a definitive trial to examine the efficacy and long-term effectiveness of WBI-BACK programme for nurses and other health care workers in the Saudi Context.

Dedication

To my dear Father

To my dear mother

To my beloved husband

To my beautiful children

List of publication and presentations

Journal Publication

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List of Abbreviations

LBP	Low Back Pain
NOLBP	No Low Back Pain
KSA	Kingdom of Saudi Arabia
UK	United Kingdom
WBI-BACK	Web-Based Intervention Programme for Self-Management of LBP
MMR	Mixed Method Research
KFMC	King Fahad Medical City
TAM	Technology Acceptance Model
SPSS	Statistical Package for the Social Sciences
WRLBP	Work-Related LBP
NICE	National Institute for Health and Care Excellence
SCT	Social Cognitive Theory
TPB	Theory of Planned Behaviour
SDT	Self-Determination Theory
mHealth	Mobile Health

EHRs	Electronic Health Records
EMRs	Electronic Medical Records
AMCs	Academic Medical Centres
PA	Physical Activity
SR	Systematic Review
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analyses
RCT	Randomised Controlled Trial
OECD	Organisation for Economic Co-operation and Development
NSLBP	Non-Specific Low Back Pain
PR	Primary Researcher
CRD	Centre for Reviews and Dissemination
ETMI	Enhanced Transtheoretical Model Intervention
CBT	Cognitive Behavioural therapy
TTM	Transtheoretical Model
IPAQ	International Physical Activity Questionnaire
BPAQ	Baecke Physical Activity Questionnaire

CSS	Current Symptom Score
NRS	Numeric Rating Scale
RMDQ	Roland Morris Disability Questionnaire
ODQ	Oswestry Disability Questionnaire
SF-12	12-Item Short-Form Health Survey
FABQ	Fair Avoidance Beliefs Questionnaire
FABQ-PA	Fair Avoidance Beliefs Questionnaire-Physical Activity subscale
SEE	Self-Efficacy for Exercise scale
PEDro	Physiotherapy Evidence Database
WP	Walking Programme
EC	Exercise Class
UP	Usual Physiotherapy
E	Education/Advice Group
EWP	Education/Advice and Walking with Pedometer Group
MRC	Medical Research Council
BCTs	Behaviour Change Techniques
BCW	Behaviour Change Wheel

IT	Information Technology
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
HELM	Health E-learning and Media
RLO	Reusable Learning Objects
NIHR- NETSCC	National Institute of Health Research-Evaluation, Trials and Studies Coordinating Centre
TIDieR	Template for Intervention Description and Replication
NIHR	National Institute of Health Research
IRB	Institutional Review Board
WHO	World Health Organization
MDC	Minimum detectable change
VAS	Visual Analogous Scale
SRQR	Standards for Reporting Qualitative Research
UoN	University of Nottingham
WBIs	Web-Based Interventions
PAR-Q	Physical Activity Readiness Questionnaire
UoN	University of Nottingham

MET

Metabolic Equivalent of Task

Chapter 1: Introduction and Background

This chapter presents and evaluates the existing knowledge relating to LBP in the nursing sector, its prevalence, predisposing factors, impacts, management and treatment options. The importance of a digital intervention for the management of LBP in the health care setting is also substantiated in this chapter, together with a justification for web-based intervention as an intervention tool for self-management of LBP. Each of these topics will be presented in the following sections.

1.1 Introduction

Nurses have the highest incidence rates of LBP related to their role and the duties associated with it; this is primarily due to the fact that the nurses' job description comprises personal, physical, and ergonomic risk factors that predispose them to LBP (Van Hoof et al., 2018). As a consequence, the predisposition of nurses to LBP means that thousands of workers in the nursing profession cannot meet the efficiency levels needed to discharge their duties effectively, which forces many of them to receive medical reports or retire prematurely (Nourollahi, Afshari and Dianat, 2018; Soylar and Ozer, 2018). Bending forward for prolonged periods while nurses discharge their duties or over-loading some parts of the body during the repositioning of patients and increasing the time dedicated to patient care means that nurses face a unique and therefore increased risk of developing LBP (Van Hoof et al., 2018). Body movements for nurses, such as clasping hugging, reaching forward, holding, lifting, and turning patients, pose an increased risk for the emergence of the LBP problem among nurses (Soylar and Ozer, 2018; Baur et al., 2018).

This predisposition to developing LBP makes nurses one of the core groups to be examined for this phenomenon, (i.e., LBP). To understand the scale and complexity of this issue, it is necessary to evaluate this challenge's development, risk factors, prevalence, and impact on

those individuals who are affected by it, their families and communities (Nourollahi et al., 2018). This section examines the prevalence of LBP among nurses globally, occupational LBP in nurses, the predisposing factors of LBP among nurses, and the impact LBP has on the ability of nurses to operate and function on both a professional and individual basis. This analysis will provide a robust basis for examining the occurrence of LBP and any potential interventions.

1.2 Prevalence of LBP among Nurses on the Global Scale

In global terms, the prevailing literature has reported a high prevalence of LBP in the nursing profession compared to other medical professions (i.e. physiotherapists, physicians, hospital aids, secretaries and technicians (Karahan et al., 2009). The lifetime prevalence of LBP among nursing personnel has been found to be at around the 65% mark (Davis and Kotowski, 2015). The prevalence of LBP in nurses differs throughout different countries in the world. For example, in the United States, the annual and lifetime prevalence of LBP among the nursing profession has been recorded at 40-50% and 35-80% respectively (Edlich, Woodard and Haines, 2001). Similarly, in Italy and Turkey, the annual prevalence of LBP prevalence stood at 33-86% among Italian nurses and 65-88% among Turkish nurses, respectively (Karahan and Bayraktar, 2004; Lorusso, Bruno and L'abbate, 2007).

Rezaee and Ghasemi (2014) have indicated that the frequency of LBP among nurses in high-income countries is between 15% - 64%, whereas in low to middle income nations the prevalence is estimated to be at around 79%. In the abovementioned study, Rezaee and Ghasemi (2014) measured frequency by examining the likelihood (rate) of a nurse developing LBP within a year compared to other employees in the same hospital. The research also used broader demographic characteristics, LBP risk factors, and work-related wellness and physical health. In this way, it was possible to determine LBP caused specifically by workplace exertion and, thus, establish an accurate rate of prevalence for the targeted hospital. During the course

of the study, the authors also established that examining LBP in low to middle income countries is challenging given the difficulties in finding the data required coupled with an inadequate capacity to collect accurate information for such analysis. Rezaee and Ghasemi (2014) established that in Iran, the frequency of LBP among nurses was more than 50% compared to a figure of 37.3% which constituted the average prevalence among office employees working for the same hospital in one year.

Kasa et al. (2020) conducted a systematic review (SR) of the literature examining LBP among nurses working in clinical settings in Africa. Different databases were used with the adoption of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. From the data that was available, the authors selected 19 studies which met with their inclusion and exclusion criteria and aimed to examine trends regarding LBP prevalence among nurses working in Africa. The findings indicated that between 2000 and 2018, the frequency of LBP among nurses ranged between 44.1% and 82.7%. A further subgroup analysis within the main study concluded that West Africa provided the highest rate of prevalence with a figure of 68.46%, followed by North Africa (67.95%). The authors for this study measured prevalence by examining the number of people in the sample with LBP as a percentage of the total number of individuals participating in the study. Based on this calculation, Kasa et al. (2020) observed that the frequency of LBP among nurses was considerably higher in Africa compared to Asia and the West. In a wider context, this study also demonstrated that the prevalence of LBP among nurses is substantial globally.

Roupa et al. (2008) evaluated the relationship between human activity/behaviour and LBP development. The study focused on a survey of nurses working in two hospitals in central Greece. The findings indicated that 40% of the participants stated they had experienced LBP; this translated to an average prevalence of 40% among nurses in Greece. Overall, the literature

indicated that nurses face a considerably higher prevalence of LBP compared to the general population globally. The literature also highlighted that the predisposition to LBP among nurses is linked to their core duties and activities within their profession; this is referred to as occupational LBP.

Relative results relating to LBP in nurses were also highlighted in the Gulf countries. For example, in Qatar, the rate of annual LBP prevalence among nurses was 54.3% (Abolfotouh et al., 2015). In the KSA, a high annual prevalence of LBP (61%) was reported among nurses in the Sudayer region (the central region of Saudi Arabia) (Al Dajah and Al Daghdhi, 2013). Another study by Gaowgzeh (2019) revealed a high prevalence rate of LBP (61.7%) among nurses in the country. This research also established that 66.7% of nurses developed LBP only after taking on their nursing jobs. These findings concur with another study conducted by Attar (2014), which indicated a high annual prevalence of LBP (65.7%) among nurses working at a tertiary region in Jeddah (the Western region). Furthermore, a high annual prevalence of LBP (75%) was reported among nurses working in Riyadh's KFMC Rehabilitation Hospital (Al-Eisa and Al-Abbad, 2013). In a multicentre cross-sectional study conducted by Elmannan et al. (2021) the findings showed that the LBP prevalence rate among nurses in Saudi Arabia was 65.6%. When this figure is compared to the 18.8% average rate of LBP prevalence in Saudi Arabia (Al Amer, 2020), one can deduce that nurses have a considerably high rate of LBP prevalence (Elmannan et al., 2021; Al Amer, 2020; Gaowgzeh, 2019).

1.3 Occupational LBP in nurses

Work-related LBP (WRLBP) is a prominent cause of work absenteeism and is responsible for a high proportion of occupational disability costs. Financial compensation paid out to workers due to WRLBP accounts for around 70% of all costs (Shraim et al., 2019). Among nurses, occupational LBP is especially pronounced in terms of its frequency and the extent to which it

affects the effectiveness and success of individuals in this profession. Hospital staff nurses lose an average of 750,000 days annually due to LBP (Kasa et al., 2020). This means that nurses are ranked 6th among the professions likely to lose the most work days annually due to LBP (Shah and Dave, 2012).

As previously highlighted, occupational LBP is inherently linked to nurses' day-to-day practices; for example, most of them are involved in moving patients and equipment, lifting, bending, and constant mobility that predisposes them to increased risks of developing LBP (Tomioka , Shima and Saeki , 2021; Serranheira et al., 2021). These tasks and moreover, the repetitive nature of them, placed considerable strain on nurses' backs and cause them to experience various musculoskeletal issues. According to biomechanical inquiries, strenuous activities lead to a high spinal load, which increases the likelihood of developing LBP among nurses (Tomioka et al., 2021; Kasa et al., 2020; Serranheira et al., 2020). Occupational LBP among nurses is considerably higher in low to middle income nations compared to more developed nations; the literature, however, does not examine the driving forces or triggers behind these differences. The literature also points out that nurses face the highest risk of developing WRLBP globally (Tomioka et al., 2021; Kasa et al., 2020; Serranheira et al., 2020).

1.4 Predisposing Factors of LBP among Nurses

The extant literature in the nursing/healthcare domain has recognised a number of risk factors linked to LBP among nurses. Budharni-Shani et al. (2016) have determined five types of non-modifiable and modifiable risk factors for LBP in nurses which include psychological, occupational and lifestyle factors. Occupational-related risk factors include: working hours per week, shift time, extra work hours, patient manual handling and heavy lifting (Budhrani-Shani et al., 2016). The increased quantity of physical loading for nurses (e.g. manual handling, lifting and transferring of patients) are correlated with a greater frequency of LBP prevalence (Vieira et al., 2006). Attar (2014) revealed that working for more than 10 hours per day increased the risk of developing work-related musculoskeletal symptoms in nurses. Holtermann et al. (2013) indicated that working with/handling more than 10 patients daily increased the risk of female nurses developing LBP. Additionally, ergonomic factors such as patient carrying, bending, twisting and standing increased exposure to LBP (Pillastrini et al., 2013). Rezaee and Ghasemi (2014) examined the ergonomic factors predisposing nurses to LBP using a validated questionnaire targeting 1,246 nurses in an Iranian hospital. The results indicated that nurses are considerably exposed to LBP with high rates of prevalence. Physical rotations performed by the nurses are also a predisposing factor for LBP. This underlines the role of handling patients as the chief predisposing factor for LBP among nurses (Gaowgzeh, 2019). This includes lifting patients, twisting, bending forward repeatedly to cater to their needs, and other physical exertions; all of which cause a heavy load on the spine that increases the likelihood of developing LBP (Ibrahim et al., 2019).

Nurses who have more than 20 years of experience in their job face an increased prevalence of LBP compared to those who have worked for fewer years (Dlungwane , Voce and Knight, 2018). Experience is a predisposing factor in this context because of biomechanical realities

which mean that continuous bending, lifting patients, standing for most of the day, and other strenuous activities put experienced nurses at an increased risk of developing LBP compared to the less experienced individuals in the profession (Doualla et al., 2019). The experience-linked risk of LBP is especially acute among nurses given the unique predisposition to LBP that the occupation already poses; therefore, experienced individuals in nursing compound the probability of developing the problem just through longevity in their career.

Analysis of the literature reveals that women are more likely to report symptoms linked to LBP (28.5%) more than men (18%) (Ochsmann et al., 2009). This indicates that gender is a crucial predisposing factor in the development of LBP. In this regard, women have gender-specific risk factors and are therefore predisposed to LBP; some of these aspects include smoking, depression, occupation, age, osteoporosis, degenerative disease and impairment caused by daily physical exertions (Ochsmann et al., 2009). However, it cannot be said that these risk factors are gender-specific because they are equally likely to affect both men and women in their day-to-day operations. The underlying argument that emerges here is that that these risk factors are more likely to increase LBP prevalence among women than among men (Wáng, Wáng and Káplár, 2016).

Findings from an analysis of literature indicate that nurses of all ages can develop LBP (Tomioka et al., 2021; Kasa et al., 2020; Serranheira et al., 2020). However, age is a crucial factor in shaping the prevalence, incidence, severity, and impact of LBP. Young nurses that develop LBP are likely to increase their incidence as they get older (Gaowgzeh, 2019; Ibrahim et al., 2019; Qareeballa et al., 2018). As a result, the prevalence, incidence, and severity of LBP among older nurses is higher compared to the younger ones; these findings also indicate that the impact of LBP among more geriatric nurses is considerably pronounced (Ibrahim et al., 2019; Qareeballa et al., 2018).

Growing research has linked psychological risk factors to occupational LBP that have increased the prevalence of LBP among nurses which include factors such as: job dissatisfaction, job control, time pressure and perceived high work load (Mehrdad et al., 2010; Al-Otaibi, 2015). Furthermore, fear avoidance beliefs, mental health, somatization and pain endurance appear to have a strong link to the development of LBP among nurses (Vargas-Prada et al., 2013). Workplace environments with high work pressure for nursing staff have been found to increase the risk factors for developing LBP (Roupa et al., 2008).

1.5 Impact of LBP on Nurses

LBP has extensive effects on nurses, their core responsibilities at work and their overall physical and psychological wellbeing. LBP impacts the nurses' productivity and, thus, diminishes the quality of services they are able to offer to patients (Kasa et al., 2020) . In the healthcare system in general, LBP increases the rates of work absenteeism, loss of optimal output, a decline in job satisfaction, patient complaints due to a decrease in the quality of care, and a surge in medical costs for the nurses as well as surging occupational disability (Rezaee and Ghasemi, 2014).

Nurses depend on their physical and psychological wellness to operate optimally and offer the best services to patients (Rezaee and Ghasemi, 2014). However, this dependence on physical actions (constant movement, twisting, bending, lifting, and moving patients) increases the risk and incidence of LBP. At the same time, the significant impact of LBP has its impact in terms of limiting the core aspects of the nurses' profession, which relies quite heavily on physicality and mobility (Gim, 2017). These dynamics indicate that nursing is a "self-limiting" career that eventually takes away the abilities and capacity of individuals to continue performing at their best level. However, this argument does not consider the dynamic showing that other careers also pose LBP risks, which, in turn, limit the abilities of workers to discharge their duties

(Negash and Mengesha, 2021; Gim, 2017). Overall, LBP causes pain and discomfort that, in the medium to long term, affects performance and ability to consistently report for work and offer competitive services (Tomioka et al., 2021; Kasa et al., 2020; Serranheira et al., 2020).

1.6 Management and Prevention of LBP among Nurses

Identifying the main interventions for LBP in nurses is vital to improve quality of life, work productivity and to eventually reduce the economic costs associated with the guidelines management of LBP (Dawson et al., 2007). An extensive SR of literature focusing on the management of occupational LBP emphasises the need for any potential solutions to be both workplace-related and focused on individual healthcare interventions (Waddell and Burton, 2001). This thesis has focused on different intervention approaches for the self-management of LBP among nurses, as this ensures that the content of a web-based intervention programme is attributed to the guidelines management of LBP. The following section will provide a brief background and overview of the different management approaches which are linked to the phenomenon of LBP among the nursing profession.

1.6.1 Workplace Environment

These intervention programmes at the workplace aim to teach nurses the correct lifting techniques and decrease the mechanical demands of the work. These include: (1) enhancing knowledge about lifting and manual handling techniques, (2) educational and awareness training programmes (Hodder et al., 2010), (3) mechanical lifting and lift assisting (Pellino et al., 2006) and; (4) utilizing mechanical floor lifting tools and transfer belts (Evanoff et al., 2003).

O'Sullivan et al. (2012) have indicated that the prevention and management of LBP should focus on tweaking the workplace environment and prioritising the wellbeing of workers,

primarily through the mitigation of risk factors and those aspects linked to LBP. Education and awareness regarding potential LBP risk issues are essential for those workers or individuals who have a high risk of developing these problems. For example, the implementation of present-day (contemporary) knowledge regarding LBP in the workplace environment could reduce LBP prevalence by between 30% and 50% (Werner et al., 2007). Education and awareness efforts can help provide knowledge and understanding of LBP and its predisposing/risk factors can be an effective intervention for occupational LBP (O'Sullivan et al., 2012 ; Werner et al., 2007). A recent study conducted in the KSA by Alghadir et al. (2021) aimed to assess the influence of workplace-based educational programmes on the knowledge of potential risk factors of occupational LBP among nurses working in the KFMC Rehabilitation Hospital. Their results showed a significant improvement in knowledge after 6 months follow-up and a decrease in the incidences of back pain from 71.5% to 65% among nurses who attended the safe handling workshops.

Ergonomic approaches such as job re-design can effectively address LBP. These comprise a holistic evaluation of the core physical demands of a job to highlight the aspects contributing to LBP, such as static/postural efforts, physical work, exposure to whole-body vibration, and dynamic workload (Halpern, 1992). Task analysis allows individuals, managers and healthcare facilities to address work-related predisposing factors for LBP affecting nurses (Driessen et al., 2010). Ergonomic methods also comprise physiological, biomechanical, and psychological measurements which can be used to establish comprehensive evaluations, management and prevention interventions among nursing staff (Driessen et al., 2010; Halpern, 1992). A study conducted by Rasmussen et al. (2015) to assess the effectiveness of a 3-month intervention in the workplace including ergonomics, physical exercise and cognitive behavioural training demonstrated that absenteeism and pain intensity attributed to LBP can be decreased among the nursing population. Another study shows small decrease in pain intensity for nurses with

LBP , and this can attribute to decrease the long term sickness absence (Andersen et al., 2012). Overall, previous studies have confirmed the positive role that can be played by improvements in knowledge and awareness as well as ergonomic intervention approaches to reduce the risk and prevalence of LBP among nurses.

1.6.2 Individual intervention

Management and prevention of LBP among nurses can be achieved through different approaches. The majority of practice guidelines offer similar recommendations regarding approaches for assessing and managing LBP. Some suggestions include employing a biopsychological framework as the core guide in the initial management of non-pharmacological interventions (Foster et al., 2018). These guidelines also comprise education, exercise therapy, self-management, increased PA and essential psychological programmes for individuals with persistent symptoms.

The international guidelines are consistent with those that are also encompassed in the national framework for the United Kingdom (UK). According to the National Institute for Health and Care Excellence (NICE), the emphasis in managing LBP focuses on using non-pharmacological approaches to improve people's lives by advancing effective and affordable/accessible forms of care for LBP. For example, NICE recommends that physiotherapists provide information and advice alongside exercise and manual therapy options (Murtagh et al., 2021). This means the focus is centred on offering a comprehensive approach that reduces cost, is accessible while optimising the chances of addressing LBP.

Most studies focusing on the management and prevention of LBP indicate that exercise therapy is a crucial component commonly used to prevent and manage pain (Murtagh et al., 2021; de Campos, 2017). For example, regular stretching of tendons, muscles and ligaments that support

the spine is essential for all exercises designed to address LBP (Oliveira et al., 2018b). Stretching helps in reducing tension in muscles, enhancing the range of motion and mobility, and minimising the risk of disability resulting from LBP (Foster et al., 2018). Strengthening exercises help build up the power and resistance of the main muscles in supporting the spine; robust midline support is crucial in minimising the stresses placed on the lumbar spine (lower back), which enhances the prevention or management of LBP (George et al., 2007). Abdominal, buttock, and hip abductor exercises are some of the strengthening approaches used to prevent and manage LBP. Resistance, stabilisation, coordination, and/or strength exercise programs are essential and effective interventions in managing and preventing LBP (Searle et al., 2015). It has been reported that exercise (e.g. walking or swimming for 45 minutes, three to four times per week) has a positive impact on the management and prevention of LBP (Al-Otaibi, 2015).

Finally, disparate approaches such as lumbar supports (including back belts), chair backrests, sitting positions (dynamic sitting) and training workers can encourage interventions and minimise the risk of LBP (Feyer et al., 2000; Frank et al., 1996).

1.6.3 Biopsychosocial Approaches to the Management of LBP

Biopsychosocial approaches consider the psychological, biological, and social factors affecting the experience of and coping with LBP (Nielson and Weir, 2001). This inherent approach allows for a broad range of management and treatment options, enhancing potential success. According to Social Cognitive Theory (SCT), environmental factors including the actions of others and individual experiences, have a crucial influence on the health behaviours of people. This means that the behavioural and altitudinal approaches adopted in the workplace and across the community can affect the ability of people to manage and prevent LBP (Wijekoon et al., 2020; Hewitt, Sephton and Yeowell, 2020; Shebib et al., 2019; Sandal et al., 2019). SCT is

especially crucial for professionals susceptible to LBP such as nurses; therefore, it is essential to establish a robust environment for nurses filled with advice and information to manage or prevent LBP among nursing personnel.

Behaviour changes theories such as SCT, Theory of Planned Behaviour (TPB) and Self-Determination Theory (SDT) examine the change of human conduct and attitudes; this framework focuses on environmental, behavioural and personal traits as the core factors driving conduct change (Ben-Ami et al., 2017; Irvine et al., 2015b; Hurley et al., 2015a). In this regard, nurses must operate in an enabling, supportive and encouraging environment to facilitate the adoption of approaches and behaviours that optimise the management and prevention of LBP, especially when it comes to work-related LBP. The Transtheoretical Model of Health Behaviour highlights the six stages of behavioural change which include: *pre-contemplation*, *contemplation*, *preparation*, *action*, *maintenance* and *termination* (Hewitt et al., 2020; Wijekoon et al., 2020; Shebib et al., 2019; Sandal et al., 2019). This model indicates that LBP management is as much a psychological process as it is a physical, social, and biological one; this underscores the importance and potential effectiveness of the biopsychosocial methods.

The self-management approach, as an LBP intervention, focuses on an individual's central role in managing their health. It comprises strategic approaches in assessment, client empowerment, collaborative care and enhanced capacity (Du et al., 2020). This approach links affected individuals to the community's resources and adopts a holistic and lifelong approach to self- and health care. This can be an effective strategy among nurses with LBP given their knowledge of the healthcare process and ability to adhere to care instructions. Self-management can also be effective in preventing and managing LBP among nurses given the high prevalence of this condition that exists among them and the occupation-linked risk factor they face. Healthy lifestyle and healthy eating are also from among the crucial interventions that can be adopted within a biopsychosocial method (Du et al., 2020). Maintaining weight

gain and advancing the physical wellness of an individual can also be effective in reducing their exposure and predisposition to LBP (Prompuk et al., 2018). These interventions are critical among nurses because they can help them to significantly reduce the risk and severity of LBP, while minimising the likelihood of disability for those nurses affected by this condition.

1.6.4 Physical Activity Intervention

PA intervention represents the first line of LBP management. According to the literature, participating in regular PA and exercises can be effective in preventing and managing LBP (Alzahrani et al., 2019; Gordon and Bloxham, 2016; Yip, 2004). Based on the biopsychological approach of LBP, PA can lead to low level of disability in patients with LBP (Verbunt et al., 2003). De Jesus-Moraleida et al. (2020) has revealed that PA interventions can be effective in managing and preventing LBP. However, PA interventions cannot be applied in isolation; rather, there is a need to adopt PA as part of a more comprehensive, holistic approach comprising occupational, organisational, behavioural and attitudinal measures designed to manage and prevent LBP. For example, adopting PA without addressing the underlying risk factors such as lifting, twisting, bending and high spinal load (among nurses), might not be effective. Additionally, De Jesus-Moraleida et al. (2020) have argued for the need to employ psychosocial and psycho-professional measures alongside physical interventions to enhance the effectiveness of addressing/mitigating LBP and its associated disability. Managing the physical levels (i.e. BMI and body weight) of an individual is crucial in advancing the likelihood of a successful PA intervention in managing and preventing LBP (Smuck et al., 2014). For example, Smuck et al. (2014) and Sitthipornvorakul et al. (2011) have argued that conditions such as body weight (obesity) and physical wellbeing play a central role in shaping the interventions adopted against LBP.

A SR of 12 observational studies, which included five cross-sectional and seven cohorts, examined the relationship between PA and LBP outcomes (Hendrick et al., 2011). The core findings reveal that PA is neither associated with nor predictive of pain levels or disability resulting from LBP. Oliveira et al. (2018a) conducted a single-blind, two-group, randomised controlled trial (RCT) comprising 160 adults with non-specific LBP (NSLBP). The findings indicated a significant correlation between enhanced and targeted PA and reduced pain levels, improved management abilities, and a decline in disability among LBP patients. A recent SR conducted by Alzahrani et al. (2019) explored the effectiveness of incidental PA interventions compared to other interventions employed in the management of LBP. The findings indicated that spontaneous PA improved the disability resulting from chronic LBP. To this end, PA can be applied as an intervention to manage the severity of LBP while preventing disability (Amorim et al., 2016 ; Gordon and Bloxham, 2016).

A Norwegian prospective study employed data drawn from the community based HUNT2 and HUNT3 surveys with 8,452 men and 9,616 women without LBP, and sought to examine the interaction between PA and the risk of LBP (Heuch et al., 2016). The findings underscored a robust association between PA (including leisure-time exertions) and the risk of developing LBP. The findings highlighted a U-shaped relationship between PA and LBP; this means that PA interventions can mitigate the pain and disability resulting from this problem; at the same time, over-exertion (excessive PA) can also increase the risk of developing LBP. Heuch et al. (2016) also highlighted the need to adjust the findings based on core factors; these include occupation (employment), education, body mass index (BMI) and smoking.

The emergent pattern in this case points to PA interventions improving short-term pain and minimising the likelihood of disability among people with LBP. For example, Kongsted et al. (2015) conducted a longitudinal study involving 1,082 participants with NSLBP . The findings

indicated that PA intervention offered considerable improvement to their LBP over a 1-year follow-up period. However, the same study showed that some patients did not demonstrate marked improvement due to their lack of motivation and adherence to the established PA intervention measures. However, this evaluation also reveals a need for adherence by patients over long periods; a significant challenge for many individuals, which results in a rapid decline in clinical outcomes after the discharge. Another SR of literature by Shiri and Falah-Hassani (2017) stated that PA (even leisure-time exertions) could have a positive impact on managing and preventing LBP. For example, according to Shiri and Falah-Hassani (2017) physically active people with chronic LBP experienced less pain (by -0.6 points on the numerical pain scale) and disability (by -8.7 points on the disability scale) compared to those not maintaining equally adequate physical activity.

Overall, lack of PA has been established as a causal risk factor for LBP; as a result, PA intervention is widely used and advocated in the literature as a means of preventing and managing LBP. This intervention (if correctly applied and maintained) could allow nurses to be more resistant to the physical effects of their job and a predisposition to LBP.

1.7 Digital Intervention in Healthcare

1.7.1 Overview of Digital Intervention in the Healthcare Setting

An analysis of the extant literature shows that digital intervention in healthcare is a broad, multidisciplinary concept that covers the meeting point between healthcare and technology. Overall, digital health is underpinned by the integration of digital transformation to the healthcare industry mainly by incorporating hardware, software and services into the care process (Ross et al., 2018). Based on this conceptualisation of digital health, prominent examples include mobile health (mHealth) applications, the use of electronic health records (EHRs), wearable devices, electronic medical records (EMRs), telemedicine, telehealth, web-based services and personalised medicine. The main stakeholders in digital health include practitioners, patients, application developers, researchers, medical device manufacturers and distributors (Fortuna et al., 2019; Ross et al., 2018). Looking at the prevailing global trends and patterns in the application of contemporary digital health, it is apparent that this technology utilises more than just tools and technologies to provide care. It also makes use of interoperable data, open and secure platforms and artificial intelligence (AI) to ensure that care being provided is patient/consumer-focused and prevention-oriented (Fortuna et al., 2019). Digital health approaches disrupt the traditional techniques by overcoming the underlying challenges and limitations, such as distance, patient access, transport challenges and difficulties associated with data. These technologies are essential among patients with disorders such as chronic musculoskeletal pain, diabetes and other cardiovascular diseases, which often require frequent visits to healthcare facilities due to continuous monitoring. This is especially the case when using telemedicine, telehealth, web-based services, mobile health (mHealth) and personalised medicine (Fortuna et al., 2019; Torous et al., 2019; Ross et al., 2018).

The increasing adoption of digital interventions also poses considerable challenges in its ability to be successfully applied and integrated across populations. For example, the ease of use among specific communities or people might hinder the acceptance of technologies as a fundamental approach to care provision (Awad et al., 2021). Some of the factors that may impede the acceptance of technology include uncertainties linked to digital health laws and policies as well as a failure to establish accountability within the commercial industry. Low levels of health and digital also literacy hinder the use of digital interventions, particularly among the elderly (Fortuna et al., 2019; Torous et al. 2019; Ross et al., 2018). Ethical challenges regarding the collection, storage and use of patient data, availability of infrastructure and the adequacy of resources in some countries (especially in the developing world) can also affect the usage of digital interventions (Organization, 2019).

1.7.2 Digital Intervention and Management of LBP

An examination of the digital interventions available in healthcare shows that they can be employed in managing and preventing LBP. As for empirical data, a SR of bibliographic databases from 2000 and 2016 was conducted by Nicholl et al. (2017) to examine digital interventions for LBP self-management and their outcomes. The study's findings indicated that digital interventions (mainly web-based methods) effectively developed a robust channel of communication between the patient and their physician, which enhanced information flow, knowledge development and awareness creation among LBP patients regarding the management and prevention of the condition. Web-based services offer robust support for self-management of LBP, which leads to enhanced patient outcomes. The interactive digital interventions are supportive to patients while providing helpful information to physicians, which assists in the delivery of personalised and customised care (Nicholl et al., 2017).

Interventions against occupational LBP need to be customised to meet the underlying needs to address risk and predisposing factors within the work environment and routines of the affected individuals. A combination of SR and an interview approach geared toward collecting data from five medical research teams and four technical partners showed that digital support interventions could effectively address occupational LBP, primarily through self-management and prevention (Svendsen et al., 2019). A questionnaire survey targeting 100 office workers with sub-acute LBP was carried out by Del Pozo-Cruz et al. (2012) to examine the effectiveness of web-based interventions in improving and preventing LBP among employees at the office. Participants in this study were asked to engage with the web-based intervention for 11 minutes, five days per week at their workplace. Their findings indicated that the group which received web-based care experienced an improvement in LBP disability and quality of life by a mean of -7.36 and 0.24 points, respectively.

Furthermore, an analysis of a nine-month web-based intervention in sub-acute NSLBP patients was carried out by Del Pozo-Cruz et al. (2013), where the authors employed a prospective single-blinded randomised intervention for their study. The target sample comprised 100 office employees with NSLBP. 50 from among these employees, who represented the intervention group participants, were trained and educated about sitting correctly and performing duties in ways that reduced predisposition to LBP; this included exercise routines (stretching, strengthening, mobility, and postural stability). The remaining 50 participants did not receive the web-based intervention. The findings show that the workers in the experimental group that received the web-based intervention improved considerably in comparison to the control group. In this regard, web-based interventions help evaluate some of the core tenets of managing and preventing LBP; these include physical activity, exercises, educational components and monitoring the feedback from the LBP patients. A structured and step-by-step approach to an intervention against LBP offers a robust basis for managing and preventing occupational LBP;

this is important given the evidence-based focus of such web-based interventions (Svensden et al., 2019).

Web-based interventions are increasingly being adopted as an option in the management and prevention of LBP; particularly due to the proliferation of technology and willingness among patients to adopt new, flexible, dynamic, convenient and effective interventions in their healthcare. Garg et al. (2016) carried out SR to examine web-based interventions directed at adults with LBP. Their findings indicated that web-based approaches improve patient outcomes. Moreover, Garg et al. (2016) demonstrated that web-based techniques improve attitudes and behaviours among LBP patients, enhancing the quality of results. Web-based interventions provide interactive and tailored platforms that can help boost knowledge, minimise the instances of health-related adverse effects and assist in customising care to achieve enhanced outcomes (Hewitt et al., 2020; Wijekoon et al., 2020; Svensden et al., 2020; Weymann et al., 2015).

For nurses, web-based interventions could provide a continuing platform for organisational, personal, behavioural, attitudinal and psychosocial approaches to managing and preventing LBP (Del Pozo-Cruz et al., 2013; Tung et al., 2014). Through a questionnaire survey of 320 female nurses from two hospitals in Taiwan, Tung et al. (2014) examined the efficiency of employing web-based education as an LBP intervention to prevent and manage its hazards among nurses. Their findings indicated that web-based approaches can be effective in educating, enhancing awareness, training and shaping nurses' attitudes regarding LBP and its underlying risk factors. Web-based processes allow nurses to develop tailored approaches that strengthen the effectiveness of interventions in managing and preventing LBP (Martorella et al., 2017). It should be stressed that the management and prevention of LBP among nurses relies on a collective approach and responsibility that includes both the organisation and the

nurses (individually). Web-based interventions allow for a holistic approach that helps the employers (health sector) play a leading role in tackling occupational LBP among nurses through training, education, resource allocation and psychosocial as well as psycho-professional support.

Overall, the literature reveals that managing and preventing LBP requires training, awareness and educational approaches to help individuals manage this problem effectively in both the short and long term (Sandal et al., 2020). This is particularly the case when applied to occupational LBP given the inherent predisposition of individuals that may be affected by LBP through their day-to-day jobs. Therefore, it can be inferred that web-based interventions create a continuous learning environment that bolsters the quality and effectiveness of self-management of LBP (Hewitt et al., 2020; Wijekoon et al., 2020; Svendsen et al., 2020; Weymann et al., 2015). The adoption of telemedicine and mobile health (mHealth) exposes LBP patients to adaptable, flexible interventions, which can help them achieve relief and improved quality of life. In this regard, digital interventions (such as using mobile devices in delivering care) encourage the use of a multidisciplinary pain treatment programme, including the biopsychosocial disease model, which addresses the biological, psychological and social aspects of LBP, thus, encouraging positive patient outcomes (Hewitt et al., 2020; Wijekoon et al., 2020; Svendsen et al., 2020; Weymann et al., 2015). Digital interventions focus on offering patients the best care instead of giving unnecessary diagnostic procedures such as vertebral and spinal imaging, surgery and pharmaceutical treatment (Nicholl et al., 2017) . The implication is that web-based interventions could be feasible and effective in bolstering the health-related quality of life and functioning among nurses with LBP.

1.8 Social Context in the Kingdom of Saudi Arabia

1.8.1 The Kingdom of Saudi Arabia (KSA)

The KSA is the largest country in the Middle East occupying most of the Arabian Peninsula (Figure 1). Its social context is heavily shaped by Arab and Islamic culture. The Kingdom's population currently stands at 33.55 million and this number expected to increase to 39 million by 2030 (General Authority for Statistics, 2020). Society with the Kingdom is deeply conservative, religious, family-oriented and traditional (Almuayqil, 2017). A majority of the attitudes, behaviours and customs are derived from Arab civilisation, Islamic heritage and are typically centuries-old (Alrashidi and Phan, 2015). Against this backdrop, a further analysis of the KSA's social context shows that the country has been affected by rapid transformational change as it (the nation) has managed to make a successful transition from a largely impoverished nomadic society into a rich commodity-based economy over the last 40 years (Alrashidi and Phan, 2015; Nieva, 2015). The KSA has experienced rapid economic development from 2003 to 2014 and now ranks as the 19th largest economy in the world. The Saudi government have provided the finances for a 450 billion dollar investment in the nation's infrastructure, health and education sectors which has increased quality of life and living standards (Moshashai, Leber and Savage, 2020). The evolving cultural and social contexts in the KSA are highlighted by the shifts in gender roles, with the recent royal decree allowing women to drive. Technology has also given different groups in the KSA, including women, an increased say in their role within society (Alrashidi and Phan, 2015). This is demonstrated by the high number of women using online platforms, including social media.



Figure 1 Map of Saudi Arabia (Al-Hazmi, 2017)

1.8.2 Health Care System in the KSA

Saudi Arabia's healthcare sector is a national government-supported system that provides free care services to people through several agencies. Healthcare is free for all Saudi citizens working within the government or private sectors. The Ministry of Health (MoH) is the lead agency of the government charged with responsibility for providing curative, preventive and rehabilitative care services in the KSA. To provide this service, MoH uses a dedicated network of more than 1,925 centres across the Kingdom (Almalki, Fitzgerald, and Clark, 2011).

The MoH is crucial in the planning, management, financing and regulation of the healthcare sector. This means that the government plays a crucial role in shaping the strategic direction the Kingdom's healthcare sector adopts (Rahman, 2020). This includes determining the crucial role played by the private sector in the provision of healthcare in the KSA. Currently, the e-Health system is expanding significantly for many organizational , for example academics , clinicians, and policy makers for investigating electronic medical records and health services (Alsulame, Khalifa and Househ, 2016).

1.8.3 Digital Intervention in the KSA

The KSA is currently in process of catching up with global trends linked to digital interventions in healthcare. The extant literature has highlighted that most high-income countries have advanced levels of digital medical interventions, high rates of acceptance among patients and fast rates of innovation and creativity in the integration of technology in the healthcare sector. The Saudi Government have made a concerted effort to effect fundamental changes in the function and structure of its healthcare system through the mechanism of the National Transformation Programme, to achieve effective quality care and service delivery (Alharbi, 2018). One of its strategies involves improving the population's overall health through developing and improving digital health approaches and implementing telemedicine in the Saudi healthcare sector (Alharbi, 2018).

Al Kuwaiti, Al Muhanna, and Al Amri (2018) investigated the use of digital health technology at academic medical centres (AMCs) in Saudi Arabia through a SR. The findings indicated that AMCs were leading the way in terms of adopting digital interventions in healthcare. The primary digital interventions widely employed in the KSA at present include electronic health records (EHRs), video-imaging technologies, smartphones, virtual desktop infrastructures and smart beds (Al Kuwaiti et al., 2018). An evaluation of the existing literature has revealed that digital interventions have demonstrably improved the quality of care being provided to patients. The use of integrated health intervention for remote patient monitoring in Saudi Arabia and Pakistan shows that technology can be effectively used to monitor, treat and educate patients needing long-term medical care (Aldahmash et al., 2019).

Although research in the area of digital health intervention is rapidly growing, few studies have been conducted in the KSA. Studies conducted in the KSA have generally focused on diabetes (Alzeidan et al., 2019; Al-Rubeaan et al., 2013) and mental illness (Alhadi et al., 2021), with

no studies to date having previously examined the use of digital intervention for people with chronic musculoskeletal conditions. An RCT conducted by Alzeidan et al. (2019) involving 1,016 eligible Saudi adults recruited from the Heart Health Promotion study at King Saud University in the KSA, to examine the effectiveness of employing digital health to prevent or delay type-2 diabetes in patients with impaired glucose tolerance. The findings demonstrated the effectiveness of digital interventions in addressing long-term care needs among patients. A quantitative observational cross-sectional study carried out by Alhadi et al. (2021) used a convenience sample of 121 mental health professionals working in tertiary hospitals in Saudi Arabia. The findings established that most of the participants were open to the use of technology in caring for individuals living with mental health disorders; they also believed in the efficacy of digital interventions in caring for patients. In the analysis of this study, it was noted that work-related and demographic factors did not affect the acceptance levels of using technology in Saudi Arabia to care for the mentally ill. Having an environment in place that is prepared for digital interventions in healthcare is essential in shaping the continued growth and expansion of these approaches across the healthcare sector in the KSA. In another study, Al-Anezi (2021) conducted a cross-sectional evaluation through a self-administered structured questionnaire to collect data from 129 participants (most of them had diabetes and cardiovascular disorders) to examine the adoption of e-health systems in the KSA. The findings indicated that a significant proportion of the Saudi populace is reluctant to adopt the kind of e-health systems that have been promoted in the Saudi Vision 2030 strategic plan mainly due to the lack of a robust infrastructure, awareness, skills and ability to use technology and carry out digital interventions for some staff and patients (Al-Anezi, 2021). Other potential obstacles that may prevent the adoption of effective digital interventions include fears surrounding privacy violations linked to patient data, potential loss of personal information, inadequate numbers of

support staff, and the mistrust that exists toward doctors who use smartphones when seeing patients.

Therefore, the KSA is adopting digital intervention approaches at a slower rate when compared to the West's speed of technological integration, mainly due to scepticism among its population and an inadequate capacity at the technology level required to come up with solutions to some of the local challenges facing the Saudi health sector (AlHadi et al., 2021; Aldahmash et al., 2019; Al Kuwaiti et al., 2018). Rural parts of Saudi Arabia lack access to a sufficiently adequate infrastructure to use digital methods as an option; the rural population is also largely non-college-educated, which means that they face ease-of-use challenges when it comes to technologies and applications employed in healthcare interventions (AlHadi et al., 2021; Aldahmash et al., 2019; Al Kuwaiti et al., 2018). Investing in digital interventions will be crucial in helping rural Saudi Arabia to improve care provision, awareness and positive health outcomes regarding LBP. However, the Kingdom is moving toward an integrated infrastructure and capacity development. It is seeking to enhance awareness levels among its population, which will help it meet its Vision 2030 strategic target of a robust rollout of digital interventions in healthcare to bolster outcomes among patients (Alzeidan et al., 2019).

1.8.4 Nursing Profession in the KSA

The nursing workforce accounts for the largest group of health professionals in the KSA, and they play a key role in the operations of the healthcare sector and its ability to offer high quality care services to the Kingdom's population. An analysis of the KSA's number of nurses per head of population illustrates that it is about two-thirds of that of the Organisation for Economic Co-operation and Development (OECD) average. However, Saudi's nursing workforce is highly dependent on expatriates (Alluhidan et al., 2020). In 2018, the number of total nurses in the KSA was around 184,565; however, only 70,319 (38 %) of that figure were Saudi nationals

(Alluhidan et al., 2020). Among the Saudi nurses, 62 % were female, compared to the 90 % of expatriate nurses. This analysis also shows that most of the expatriate nurses are Indian, Malaysian and Filipino (Al-Hanawi, Khan and Al-Borie, 2019).

The nursing profession in the KSA plays a crucial role in the healthcare sector and has shown remarkable development in recent years. Despite its progress, it can be said that this profession is still quite underdeveloped in the Kingdom; this issue is underlined by the fact there is a chronic shortage of nurses in the KSA, which is also affected by high rates of turnover. Another indicator of the sector's underdevelopment is the number of expatriate nurses operating in the country; they form a significant proportion of the nursing workforce in Saudi Arabia's healthcare facilities (Almalki et al., 2011) .

The core challenge facing the nursing profession in the KSA is that it is a less desirable career choice for Saudi nationals when compared to other professions in technology and the humanities. This is primarily because of the perceptions of challenges facing nursing practitioners in the country, which have spilled over into society and fed or reinforced the negative perception of nursing (Lamadah and Sayed, 2014). As the Saudi government has sought to commit major resources to bolster the healthcare sector, with the core goal being the provision of free and accessible health services to all Saudi nationals, it is crucial to work on improving the conceptualisation of nursing if the service wants to grow and have a good image in the eyes of Saudi society.

1.8.4.1 Nursing Scope of Practice

The nursing scope of practice is underpinned by five aspects; these include “who,” “what,” “where,” “when,” and “why,” which are further expounded below:

Who – This comprises individuals that have been educated, are titled and maintain active licensure to practice nursing; they include advanced practice registered nurses and registered nurses (Schluter, Seaton, and Chaboyer, 2011).

What – The scope of practice here comprises promotion, protection and optimisation of the health and ability of patients. It also includes facilitating healing, reducing/alleviating suffering (through diagnosis and treatment), preventing illness and injury and advocacy for care for groups, populations, communities, families and individuals (Fairman et al., 2011).

Where – This includes the locations/places where the patient(s) need(s) care.

When – This comprises the instances when patients need nursing compassion, knowledge and expertise.

Why – This focuses on realising positive outcomes for patients and adhering to the social contract and obligation of nursing to society.

1.8.4.2 Expatriate Nurses

The nursing workforce in the KSA relies heavily on expatriate nurses, recruited from more than 52 countries (AlYami and Watson, 2014). Differences in culture, religion, language and social values can create challenges and barriers between expatriate nurses and Saudi national patients (Al-Mahmoud, Mullen and Spurgeon, 2012). Nurses from Western countries tend to be treated more favourably than nurses from other regions, particularly in terms of finance and privileges which causes some nurses to migrate to high-income countries to find a more affable working environment (Aldossary et al., 2008).

Although the Saudi government has focused on increasing the number of Saudi nurses, the need for expatriates continues to be a pressing concern in the Kingdom. The total number of

Saudi nurses in the MoH has been growing in recent years with the percentage of Saudi national nurses versus expatriate nurses increasing progressively from 9% in 1997, 27 % in 2005, 29 % in 2008 and 37 % in 2016 (Alsadaan et al., 2021). Similarly, an examination of the private healthcare sector in the KSA reveals an even bigger proportion of and reliance on expatriates (95%) compared to Saudi nurses (making up 5%) (Elmorshedy et al., 2020). Foreign nurses in the KSA are a complex matter in which cultural diversity represents the key challenge to the development of the research among Saudi nurses. Understanding these aspects on cultural may help researchers during the delivery of intervention in establishing and gathering knowledge as well as reducing possible conflicts to the cultural differences.

1.8.4.3 Challenges Facing the Nursing Profession in the KSA

The core challenge facing the nursing profession in the KSA is the inadequate number of Saudi nurses; this shortage is the driving force behind the surge in expatriate nurses in the Kingdom. Studies show that the shortage of Saudi nurses is driven primarily by a lack of acknowledgement for Saudi nurses, working environment challenges, educational challenges and certain cultural barriers. Issues of discrimination and workplace environment difficulties (such as a gender-mixed working environment, language barrier and long working hours) have also contributed to the difficulties facing expatriate nurses in the KSA (Alsadaan et al., 2021). The negative perception of the nursing profession in Saudi Arabia is also contributing to the challenges facing expatriate nurses in the Kingdom. These challenges highlight an urgent need to improve the image of nursing in the KSA in order to bolster recruitment, job satisfaction, high retention and increased training and development of Saudi nurses in the country.

1.8.4.4 Saudi Arabia's Vision 2030 and the Nursing Profession

The core target of the KSA's Vision 2030 for the nursing profession is addressing the core challenges faced by the healthcare sector. These include nursing shortages, underdeveloped nursing education and a current scope of practice that does not meet international standards.

If these challenges are addressed, this will focus on changing the perception of nursing in the KSA, encouraging more individuals to take up nursing as a profession, thereby offering rewarding, supportive and enabling workplace environments for nurses in the Kingdom's facilities and gradually reducing the country's dependency on expatriate nurses by increasing its own pool of trained, experienced and capable nurses (Al-Dossary, 2018).

These targets for the nursing profession dovetail with the broader health targets of Vision 2030 which include reducing disparities, bolstering equity, minimising costs, enhancing technological use and maintaining patient-and-family-focused care provision.

Figure 2: Summary of Social Context in the KSA

Principal Findings

- The total population in the KSA stands at 33.55 million and this rate is expected to increase in the future.
- The religious and cultural context of the KSA is influenced by Islam and old cultural practices.
- The Saudi e-Healthcare system is expanding significantly for many organizations and individuals.
- The use of digital health interventions is aligned with Kingdom's Vision 2030 programmes and these types of innovation approaches (i.e. eHealth) aim to improve health outcomes in Saudi Arabia to reduce the economic burden of chronic diseases.
- The nursing profession plays a crucial role in the operation of the Saudi Arabian healthcare sector.
- The nursing profession is facing challenges in the KSA, which has contributed to the considerably low number of Saudi nurses employed in it; this shortage has been largely addressed by expatriate workers.
- Low job satisfaction, high turnover and heavy workloads are challenges that continually affect the nursing sector in the KSA.
- The KSA's Vision 2030 conceptualisation of the nursing profession focuses on enhancing training, addressing the negative perception of nurses in Saudi Arabia and increasing the number of qualified Saudi nurses, thus reducing the dependence on expatriate labour.

1.9 Rationale for Research Study

As established in this literature analysis, there is a broad body of evidence indicating that occupational LBP among nurses is driven mainly by their day-to-day exertions in lifting patients, twisting, bending forward and the high intensity of physicality they have to endure in discharging their duties. As a result, there is a need for organisational and personal interventions in managing and preventing occupational LBP among this group. An analysis of the extant literature indicates that digital interventions provide a crucial platform for collaboration between individual nurses, their organisations and the care staff members to address, manage and prevent LBP (Nicholl et al., 2017; Del Pozo-Cruz et al., 2013; Del Pozo-Cruz et al., 2012).

Self-management is essential in addressing occupational LBP among nurses because of their work and the fact they are continually susceptible to developing LBP. This is especially the case for those in the sector who are older, obese, or from among those that already experienced LBP. Digital interventions can offer customised exercises (or PA regimens), psychosocial, psycho-professional, organisational and behavioural interventions that can subsequently be monitored and tweaked to optimise their effectiveness in managing occupational LBP (Svendsen et al., 2022; Sandal et al., 2020; Oliveira et al., 2018a; Geraghty et al., 2018).

The downside of using digital interventions in managing and preventing occupational LBP among nurses is that these interventions rely on the self-management and discipline of affected individuals (Martorella et al., 2017). Lack of adherence or an unwillingness of patients to follow through with the agreed plan might render digital interventions problematic and ineffective. Therefore, there is a need for buy-in from all stakeholders to facilitate the success of digital interventions in addressing occupational LBP among nurses (Oktay et al., 2021; Butler and Foster, 2003). The collaborative element is typically the most attractive aspect of digital methods in healthcare; at the same time, it can also be the most problematic issue to

achieve when implementing a digital intervention plan involving nurses with occupational LBP. The evidence here has demonstrated the underlying advantages of digital interventions in healthcare provision.

For example, customisation and personalisation of care allows for improved focus on the core needs of LBP patients (Tung et al., 2014; Del Pozo-Cruz et al., 2013). Web-based intervention can provide non-pharmacological interventions including specific exercises, PA and a biopsychosocial approach which can be adopted through a self-management behavioural intervention to bolster the overarching patient outcomes for occupational LBP.

In KSA, digital interventions are being increasingly adopted in the urban areas and within technologically advanced healthcare facilities such as academic medical centres (AMCs). The KSA saw a surge in reliance on digital platforms during the COVID-19 pandemic. However, the pandemic also exposed some of the country's challenges and difficulties in its application of digital (web-based) approaches to providing care (Wijekoon et al., 2020; Svendsen et al., 2020). This points to a need to examine the development and feasibility of a web-based intervention for nurses' self-management of LBP. Nurses are predisposed to occupational LBP, which means that there is a necessity to evaluate the feasibility and effectiveness of developing the underlying infrastructure to facilitate the growth and expansion of web-based interventions for self-management of LBP.

The high prevalence of LBP among nurses working in the KSA means there is a need to establish management intervention strategies for nurses in order to reduce LBP prevalence and enhance functional activities that have a positive effect on the individuals and organizations, subsequently improving patients' care. An analysis of the prevailing literature shows that self-management is an important component of care, which includes integral elements of being educated about the patient's chronic condition such as LBP, and therefore, its management and uptake of evidence-based behaviours strategies in conjunction with other lifestyle factors

(Blanpied et al., 2017; Hurley et al., 2016). Moreover, developing a digital intervention programme has proven to be effective in decreasing the incidences of LBP, increasing PA (Del Pozo-Cruz et al., 2012; Krein et al., 2013; Pozo-Cruz et al., 2013; Irvine et al., 2015b) and these interventions have been undertaken in different Western contexts (developed countries) and settings, including the UK. To date however, no such studies or initiatives have been conducted in the KSA, especially among the nursing population. Therefore, this present study aims to test the feasibility and acceptability of web-based intervention programme developed for the self-management of LBP in nurses working in Saudi hospitals. Importantly, testing the feasibility of developing the web-based intervention in one hospital will help to determine whether it is feasible to use this intervention on a larger scale in order to examine its effectiveness. It is hoped that the details outlined in this study can be used as a foundation to implement a web-based strategy similar to those currently being employed in other developed countries.

Saudi Arabia provides a useful example to study the feasibility of developing digital interventions because it is an emerging economy with an upwardly mobile and agile population when it comes to the adoption of technologies. The strategic plan in Saudi Arabia's 2030 vision is also crucial in shaping investment in innovation and creativity, including the healthcare sector. Therefore, this study will examine emerging trends and patterns in the KSA and potential implications for the short-term and long-term fate of digital health interventions. The study is also crucial because it comes during the COVID-19 pandemic, which pushed the KSA to adopt some of the digital health intervention measures.

1.10 Study Aim and Objectives

The purpose of this study is to test the feasibility and acceptability of a WBI-BACK program developed for the prevention and treatment of LBP among the nursing population in the KSA.

Primary Research Objectives

To provide primary data about the feasibility and acceptability of delivering and assessing the WBI-BACK intervention programme for nurses with and without LBP in the KSA context. Specifically, this will involve evaluating the feasibility and acceptability of the proposed full trial including participants' recruitment rate, attrition rate, appropriateness of selected outcome-measures, intervention adherence and experiences of the intervention components based on Technology Acceptance Model (TAM).

Secondary Objectives

To determine if exploratory analysis of certain LBP-related measures are sensitive to change after the WBI-BACK intervention programme for nurses with and without LBP. This requires specifically focusing on the following:

- To measure the effects of PA level, fear-avoidance beliefs, pain intensity, physical functioning, health-related quality of life and self-efficacy before and after the WBI-BACK intervention programme.
- To identify the recommended level of PA before and after the WBI-BACK intervention programme.

Chapter 2: Investigating the Effectiveness of Physical Activity Interventions in Patients with Chronic Low Back Pain: A Systematic Review

2.1 Introduction

Promoting PA as a means for achieving physical fitness, is a recent development in healthcare, particularly for patients with chronic low back pain (CLBP). It is suggested for patients with LBP to stay physically active, as long periods of decreased PA will negatively affect recovery (Bekkering et al., 2003). Although the precise delineation of PA varies across disciplines and contexts, the phrase is often described as “any bodily movement produced by skeletal muscles that requires energy expenditure” (Bull et al., 2020). The main divergence between PA and exercise is that exercise is structured and systemised, while PA is amorphous and encompasses a broad range of movements (Piggin, 2020). Generally, PA can include any movement that contracts the muscles (Gordon and Bloxham, 2016). PA is also a crucial component of LBP rehabilitation patients.

Evidence on the effectiveness of PA as a clinical management technique for LBP is unequivocal. For instance, a Cochrane systematic review of interventions aimed at increasing PA found a positive and moderate effect on cardio-respiratory fitness among participants (Marley et al., 2014). Gordon and Bloxham's (2016) SR as well as numerous other pragmatic publications, such as Marley et al. (2014), Surkitt et al. (2012) and Mesner et al. (2016) corroborate these findings. Varied approaches have been used to increase PA in healthcare settings. Such strategies include behaviour counselling, exercise therapy, advice, journaling, record keeping and exercise referral systems (Lachman et al., 2018; Stonerock and Blumenthal, 2017; Zanetti et al., 2013; Orrow et al., 2012; Kahn et al., 2002). Based on this body of evidence, clinical guidelines often recommend the intervention, as an adjunctive to conventional pain treatments for the long- and short-term management of LBP (Oliveira et al.,

2018b; Koes et al., 2010). However, a preliminary exploration of current empirical evidence reveals a significant gap in the literature regarding the most effective strategies for promoting PA for patients with LBP. An objective study research that seeks to categorise the interventions based on the degree of efficacy is timely. Although evidence demonstrating the efficacy of PA for LBP is well-established in the literature, determining the role of intervention typology or mode of delivery in the level of potency is necessary. However, PA intervention among nurses has not been evaluated in the literature; this review could conclude that PA intervention appears promising in decreasing and preventing LBP among nursing personnel.

To address the gap in the literature, a SR was conducted to review the effect of PA interventions on LBP. The review aimed at establishing whether the mode of PA intervention delivery mediated efficacy levels. Specifically, the SR targeted studies that compared interventions delivered via digital facilitators with conventional protocols for LBP. It was hypothesised that PA digital intervention would improve the behavioural skills for self-management of LBP among nurses in term of decrease pain and disability and add to the positive effect of decreasing LBP. Consequently, the findings will identify the gap in the literature for PA interventions for patients with LBP, especially for nursing. The study's objectives are:

- 1- To investigate treatments that enhance, promote and increase PA levels in patients with chronic LBP.
- 2- Compare the efficacy levels of digitally enabled PA interventions for LBP with other interventions.
- 3- To examine and synthesise the current intervention approaches for promoting PA.

The PRISMA model was followed in reporting the findings from the studies that were reviewed (McInnes et al., 2018; Moher et al., 2009).

2.2 Methods

2.1.1 Identification of the selection trials

The electronic search was conducted based on the following databases based on the previous SR for PA intervention for LBP population (Heneweer et al., 2011, Gordon and Bloxham's, 2016 and Alzahrani et al., 2019): MEDLINE (OVID) 1996 to present, CINAHL Plus, Web of Science, PsycINFO, EMBASE (OVID), Ebsco and Cochrane library. The searches were conducted from April 2018 to June 2018 and updated in January 2022. The reference lists of the reviewed articles were also used to identify suitable studies.

As recommended by Bramer et al. (2018) and Gusenbauer and Haddaway (2020), the search strategy entailed identifying key words and synonyms from the existing literature, which were subsequently reviewed by the researcher's two supervisors for relevance. Each key word was inserted separately into the database. For instance, the phrases 'low back pain' and 'physical activity' were inserted separately. Subsequently, the key words related to the Boolean operator 'OR' between each component in PICO, and the main result of each PICO was linked with an 'AND' operator to reach the final number of studies to be scanned.

2.1.2 Inclusion Criteria

Population (P): The studies included participants with NSLBP or chronic LBP, aged between 18-70 years old, based on the previous SR for PA intervention for LBP population (Gordon and Bloxham's, 2016 and Alzahrani et al., 2019). Studies were eligible if all participants had back pain for more than three months' duration.

Intervention (I): Interventions aimed to enhance, promote and increase PA; there were no restrictions on the inclusion of a follow-up. All studies also featured at least one digitally-enabled intervention.

Comparison (C): Comparisons with other interventions - for example: waiting list, placebo, PA for LBP education, self-management care and no /minimal intervention, were considered.

Outcome measure (O): Functional disability, pain level and PA outcome measures that examine the effect of the interventions on NSLBP or chronic LBP or (either subjectively or objectively) a primary or secondary outcome measure.

Study design: The review included RCTs; quasi-nonrandomised controlled clinical trials that investigated the effectiveness of PA interventions compared with conventional intervention methods. The articles were published in English and were taken from 2013 to the present; thus, there was a significant growth in the literature regarding the innovation and implementation of digital health intervention over the last two decades. Therefore, the study focus on the recent literature.

2.1.3 Exclusion Criteria

Studies were excluded if they did not match the type of participants, study designs interventions, and publication period selected for inclusion. Studies that were published in a language other than English were also excluded.

2.1.4 Review Process

The primary researcher (PR) performed a superficial analysis of the titles and abstracts of potential studies to verify their suitability for meeting the review's primary objectives. As recommended by Gusenbauer and Haddaway (2020) and Littell (2018), after potential studies were identified, a further analysis was performed using the inclusion and exclusion criteria to narrow down the current study's scope to the most relevant publications. In addition, one independent reviewer (primary supervisor) confirmed whether the studies were related to PA interventions for LBP. The Centre for Reviews and Dissemination (CRD) recommends that two reviewers independently examine the abstracts of potentially relevant studies to determine relevance, quality and reliability. When the abstract indicated some degree of relevance, the reviewers proceeded to read and verify the full text. Studies were included after the reviewer's reached a consensus on eligibility. Discrepancies were discussed and resolved by the PR and

independent reviewer. The collaborative approach also mitigated the potential for selection bias.

2.1.5 Data Extraction

The reviewers extracted data from primary studies relative to sample characteristics, outcome measures, intervention typology and comparators. By using two independent reviewers, it was possible to minimise the potential for bias regarding the findings and interpretations (Higgins and Green, 2011).

2.1.6 Statistical Analyses

The studies selected predominantly relied on statistical evaluation to draw inferences on the correlation between PA and LBP. During the investigation, the PR ensured the margin of error and significance levels were within ± 0.05 to ensure accurate findings were generated. This measure was taken considering that 90% of the confidence interval and the odds ratios were within the set margin. In addition, different time points were established to examine the relationship between PA and LBP outcomes; the research only recorded the statistically significant relationships. Based on this approach, researchers needed to consider the heterogeneous statistical methods applied to derive critical insights on the significance of PA for patients with LBP. To resolve discrepancies, they relied primarily on univariate analyses. Multivariate analyses were disregarded due to the intricacies of handling heterogeneous data linked to this research. Besides the statistical methods, the research variables comprised PA and outcome measures.

Data Synthesis involves the combination, integration and summarization of results from included studies in the SR (Boland et al., 2017). However, the statistical pooling of the results such as meta-analysis is needed to show the intervention effect in the SR, it will not be feasible in this review due to high level of statistical and clinical heterogeneity over all studies (Haidich, 2010). Therefore, a narrative approach was presented in this review in addition to

analysis of the relationships within and between included studies. The main problem of narrative synthesis is that it is more subjective than meta-analysis, thus the approach must be rigorous and transparent to reduce the bias (Higgins and Green, 2011).

2.3 Result

2.3.1 Study selection

The initial electronic database search identified 1,601 potentially eligible studies. Two further studies were identified from the reference lists of those RCTs that were retrieved. Of the 1,603 studies, 405 were excluded as duplicate studies. After screening the titles and abstracts, 49 potential studies were considered for inclusion. A full text review of the 49 studies culminated in the further exclusion of 41 publications that fell short of the inclusion criteria, or where the study's objective did not aim to increase physical activity level.

The electronic search was updated on 15th January 2022 following the same literature search strategy. Sixty studies were identified during this phase, while only two were selected after assessing the titles and abstracts. Ten studies were identified for inclusion. After discussion with the principal supervisor, three of the ten studies were eliminated as they did not fit the eligibility criteria. Two of these studies were not based on RCT designs; one of them was a pragmatic randomised trial (Sorensen et al., 2010), while the other was a non-randomised pilot study (Balaguier et al., 2017). The third excluded trial did not aim to promote PA (Siemonsma et al., 2013). Overall, a total of seven articles were selected for inclusion in this SR. Figure 3 below illustrates a concise summary of this process.

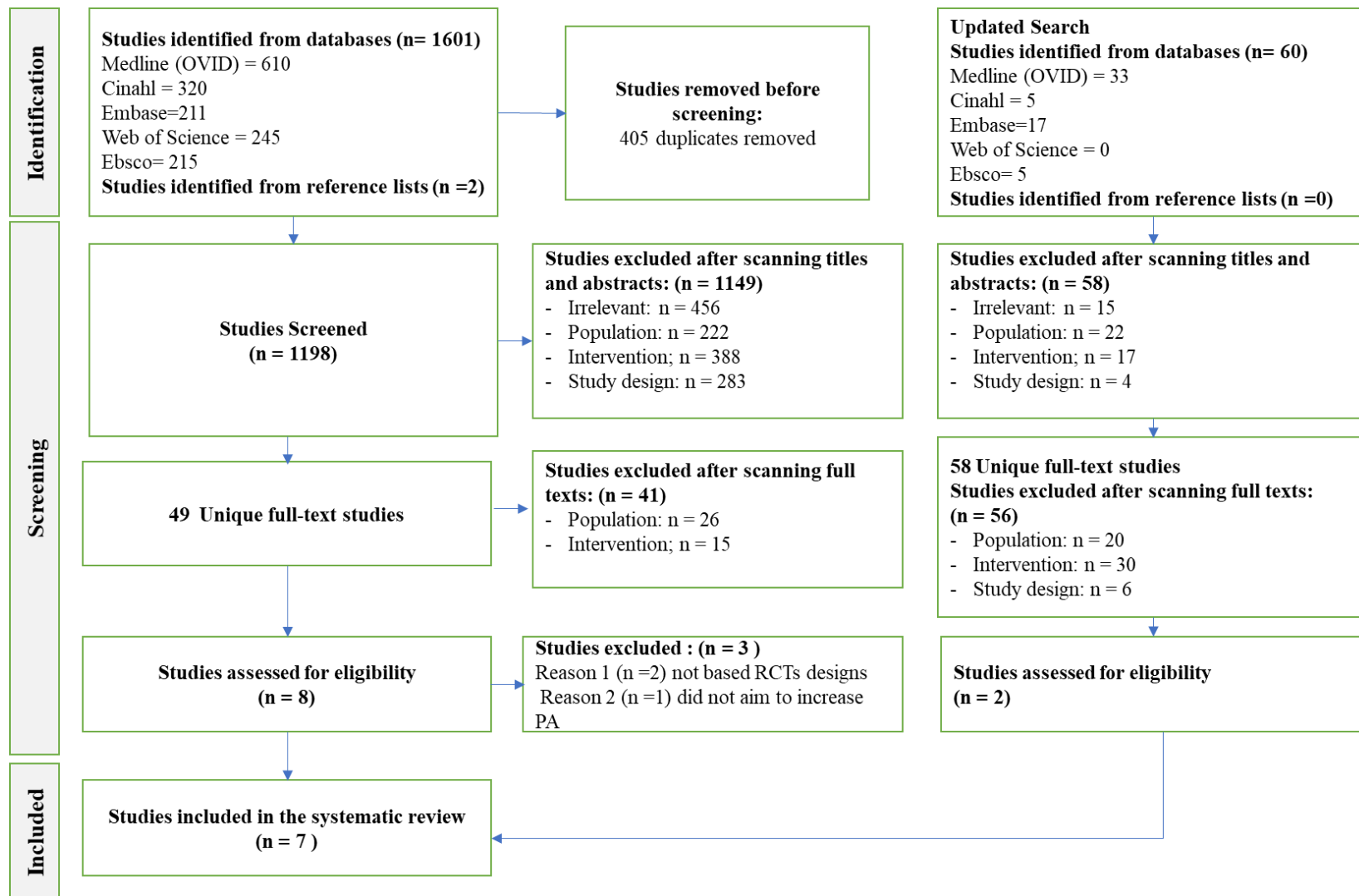


Figure 3: PRISMA Flow Diagram

2.3.2 Study Characteristics

The characteristics and results of the selected studies summarise in relation to the settings and design of the research, population attributes, outcome measures and the effect of PA interventions on LBP (See Appendix 1). A detailed discussion of each of these elements is presented in subsequent sections.

2.3.2.1 *Participants*

The study examined a diverse demographic of participants to determine the most affected populations and factors leading to LBP. Also, researchers investigated respondents working in different environments to establish those affected the most along with the causes. Based on this approach, a majority of the research comprised of participants within the boundaries of the working age population. This made up a total of 1183 participants aged 18-60 years, who were included in all seven studies.

2.3.2.2 *Types of Interventions*

For this review, numerous interventions were examined to determine their efficacy in increasing PA for LBP. They ranged from health coaching, both written and in-person and activity tracking, including coach or therapist follow-up, support and coaching (face-to-face, telephone, or app/web-based). The trial conducted by Chhabra, Sharma and Verma, (2018) was the only study that incorporated a pharmacological regimen as an ancillary to PA interventions. The following extrapolate the characteristics of interventions across all seven studies.

2.3.2.2.1 *Web-Based Interventions*

Technology dominated as a facilitator for delivering and tracking PA levels. In fact, the trial of Ben-Ami et al. (2017) did not include a digital intermediary, but rather used the Transtheoretical Model based on behaviour change principles (Geidl et al., 2014), combined intervention with increased reassurance, therapeutic alliance and exposure to reduce fear

avoidance. Studies that used web-based interventions included Amorim et al. (2019) and Chhabra et al. (2018), where participants received Snapcare, an application with regular written prescription from physicians. Geraghty et al. (2018) used the SupportBack internet intervention, a tailored program for graded goal setting, self-monitoring and provision of individual feedback to encourage PA. The study of Schaller et al. (2016) ensured that patients had access to internet-based aftercare offered on the web 2.0 platform for up to six months after the experiment. All these studies showed higher efficacy rates compared to treatment as usual that did not incorporate a digital facilitator.

2.3.2.2.2 *Mobile Health*

From the studies that included physiotherapist telephone support were those of Geraghty et al. (2018) and Amorim et al. (2019), where participants received brief phone calls to address concerns and provide reassurance. In addition to treatment as usual involving face-to-face movement training, phone calls in Schaller et al.'s (2016) trial were tailored to the patients' needs and used for follow-up purposes after in-patient rehabilitation. Similarly, participants in the study of Hurley et al. (2015b) also received phone calls in addition usual treatment and digital tracking interventions. However, the therapists' contact aimed at tracking changes in PA levels in weekly intervals rather than to offer reassurance as in the Amorim et al. (2019) study. Therapists in this latter study also provided coaching sessions during the phone calls with clients. Evidently, phone calls were used for multiple purposes such as delivering PA education, tracking changes, and encouraging participants.

2.3.2.2.3 *Digital Tracking*

Three studies used digital tracking interventions. These were Fitbit (Amorim et al., 2019) and pedometers (Hurley et al., 2015b; McDonough et al., 2013) respectively. McDonough et al. (2013) and Hurley et al. (2015b) issued participants with pedometers that recorded every step

taken and tracked changes in PA intensity and frequency. Digital tracking supplemented the manual recording of daily exercise in former authors' trial, which augmented the results' authenticity in tracking increase in PA levels during the research period.

2.3.2.2.4 *Biopsychosocial Supports*

Studies that featured biopsychosocial supports included Geraghty et al. (2018), Ben-Ami et al. (2017) and Hurley et al. (2015). These strategies ranged from walking programs training, support and follow-up and PA diaries. PA included walking, swimming, biking or gym workout (Ben-Ami et al., 2017). Hurley et al.'s (2015b) biopsychosocial supports included a weekly back to fitness program entailing warm-up and stretching.

2.3.2.2.5 *Manual Booklets/ Written Information*

Various studies integrated written instructions as part of their blended interventions for elevating PA levels. While Amorim et al.'s (2019) booklet supplied participants with sedentary behaviours information, Hurley et al.'s (2015b) written information contained walking strategies and self-monitoring tools in which participants recorded their daily walks. On its part, McDonough et al.'s (2013) Back Book information booklet contained PA advice for LBP. The manuals educated users on how to perform PA correctly, the dangers of a sedentary lifestyle, along with the benefits of PA for LBP.

2.3.2.2.6 *Face-to-Face Therapy*

Face-to-Face therapy featured prominently in the hybrid interventions. For instance, Ben-Ami et al.'s (2017) in-person treatment examined the role of the therapeutic alliance in optimising PA, while Amorim et al.'s (2019), McDonough et al.'s (2013), and Hurley et al.'s (2015b) one day, one week, or weekly in-person sessions (respectively) focused on standardised physiotherapist education in maintaining high PA levels and stretching and warm-up exercise. Similar to the Hurley's et al (2015b) study, Schaller et al.'s (2016) in-person sessions included

movement coaching. In Hurley et al. (2015b), patients also received manipulated treatment with no cap on the number of visits. However, these interventions were administered bi-weekly during in-patient rehabilitation.

2.3.2.3 *Duration, Time, and Frequency of the Interventions*

In terms of duration, the study by Ben-Ami et al. (2017) and Amorim et al.'s (2019) pilot study were similar (17 and 15 months respectively). The intervention in Hurley et al.'s (2015b) study lasted 12 months, with periodic follow-up at 3-, 6-, and 12-month intervals. Comparatively, Chhabra et al.'s (2018) study was relatively short, lasting only 12 weeks, while McDonough et al.'s (2013) interventions took about 8 weeks. During this period, participants received a one-time intervention at the onset, and had to wear a pedometer while walking during the ensuing 8 weeks. Steps taken were counted on a daily basis. PA was assessed at baseline, after intervention (9 weeks), and 6 months. Geraghty et al.'s (2018) trial was even shorter at 6 weeks, which is the recommended time for administering the "SupportBack" internet program. Follow-up consisted of three brief phone calls by the therapist to client over a one-month period. Geraghty et al. (2018) also included follow-up after three months.

Unlike Ben-Ami et al. (2017) who solely relied on a Transtheoretical Model of Behaviour Change to deliver face-to-face interventions, Amorim et al. (2019) supplemented in-person interventions with digitally delivered, tracked and monitored treatments. The latter's study trailed a health coaching model that featured multiple interventions, including digital tracking and support over a six-month period. Baseline measures were obtained at the onset while data was collected weekly for six months, which culminated with another six-month follow-up period to determine PA attrition rates. In comparison, Geraghty et al.'s (2018) follow-up period was set at three months.

In the Amorim et al. (2019) study, the intervention group received one face-to-face instruction lasting 1-2 hours, in addition to the information booklet and the development of a personalised goal setting and tracking form and 12 follow-up telephone calls twice a month over a 6-month period. On the contrary, follow-up in the Ben-Ami et al. (2017) study was not as strictly defined and lasted 3-12 months. In Amorim et al.'s (2019) trial, participants also wore a Fitbit device and were encouraged to use the web-based tool as often as possible to monitor their progress relative to set goals. Participants in the Ben-Ami et al. (2017) study received a 40-minute assessment at baseline, but subsequent sessions lasted between 20 and 30 minutes. The minimum Enhanced Transtheoretical Model Intervention (ETMI) protocol was two sessions delivered in-person.

2.3.2.4 Fidelity, Adherence and Adverse Effects

The highest adherence rate for all studies was 93% while the lowest was 46%. The latter is an outlier since 5 studies maintained adherence rates between 80% and 90%. Moreover, only one study (McDonough et al., 2013) reported unrelated adverse intervention effects on the population such as lateral ankle sprain, increased pain in the back and lower limb. In the Schaller et al. (2016) study, as with all seven studies, fidelity was not explicitly reported, but can be inferred based on the quality of the data and adherence levels. McDonough et al. (2013) had the highest adherence rate at 93% and adherence to targeted goals at 70%. The opposite was true for Schaller et al. (2016), where adherence rates for the intervention and control groups declined significantly at six months follow-up (46% and 47%) respectively. In Ben-Ami et al.'s study (2017) low adherence rates in following recommended exercises were reported in recreational PA.

In both Amorim et al. (2019) and Geraghy et al. (2018), only three participants in the intervention group dropped out. Completion rates were high at 95% in the former, while 19%

did not complete the follow-up in the latter. Similarly, a 20% attrition rate at follow-up was reported in Ben-Ami et al. (2017). Completion was recorded at 65% and deemed to have occurred when participants were discharged by their respective therapist. Geraghy et al. (2018) had a better completion rate at 84%. Adherence rates in therapist-supported groups were higher compared to internet-based.

It was interesting to note that Hurley et al. (2015b) reported similar findings, in that therapist-supported groups had better adherence rates compared to digitally supported measures. These outcomes are in spite of both studies finding that digitally-enabled interventions were significantly more effective in relation to PA for LBP. Hurley attributes this paradox to therapist supervision during treatment, which boosted accountability and commitment, and ultimately improved adherence levels. The high completion/adherence score enhanced data fidelity and reliability. Fidelity was also boosted by eliminating the survey questionnaires that were incomplete or had missing values.

Geraghy et al. (2018) is the only study that directly measured fidelity and adherence as primary outcomes. Their findings indicate high fidelity levels among trial therapists while only three participants dropped out during the study. Regarding adverse impacts of interventions on patient outcomes, six of the seven studies reported no adverse impacts, but McDonough et al. (2013) described walking-related negative effect among 35% of the sample. Related issues (n=5) included escalation of pain levels and allergic reactions to the pedometer's metallic clip.

2.3.2.5 *Theory-Based Intervention*

All studies employed behaviour change theoretical models and principles aimed at triggering some form of behaviour change to motivate participants to engage in PA. Cognitive Behavioural Therapy (CBT) and Behaviour Change Theory (Transtheoretical Model (TTM)

were selected as guiding principles for intervention in two studies (Geraghty et al., 2018; Ben-Ami et al., 2017). While McDonough et al. (2013) allude to, but do not overtly mention a specific theory or behaviour change principles, Amorim et al. (2019) is based on the behaviour change theory which suggests that adopting healthy behaviour including physical activity, nutrition and nutritious diet can significantly improve health. Ben-Ami et al. (2017) applied the ETMI to encourage recreational physical activity. Similarly, Schaller et al. (2016) also used the Transtheoretical Model in conjunction with cognitive theory as foundational behaviour change approaches. The assumption was that goal-specific steps articulated through simple and specific information had the greatest potential to trigger behaviour change. Overall, all of the studies reviewed, including those that do not explicitly comment on theoretical models, applied some form of behaviour change principles. This inclination reflects the nature of the research, which focuses on improving LBP through adapting new behaviour.

2.3.2.6 *Characteristics of Outcome Measures*

Pain, functional disability and PA outcome measures have been used in this review, while other outcome measures were not considered. All studies included in this current review assessed PA as a secondary outcome measure, whereas only one study (Schaller et al., 2016) examined PA as a primary and secondary outcome measure. Furthermore, all studies assessed PA subjectively through self-reported measures questionnaires including: the International Physical Activity Questionnaire (IPAQ) (Amorim et al., 2019; Geraghty et al., 2018; Hurley et al., 2015; McDonough et al., 2013), the Global Physical Activity Questionnaire (Schaller et al., 2016), the Baecke Physical Activity Questionnaire (BPAQ; (Ben-Ami et al., 2017). Objective measurements of PA using a pedometer were performed in two studies (Hurley et al., 2015; McDonough et al., 2013) to improve walking for patients with LBP and display an improvement in PA. Daily PA was measured in Chhabra et al.'s (2018) study, using an activity

tracker embedded within the app, while symptoms progress was assessed with the current symptom score (CSS).

For pain intensity level, numeric rating scale (NRS) was applied to evaluate back pain level in all included studies. Regarding functional disability, the Roland Morris Disability Questionnaire (RMDQ) used in three included studies (Amorim et al., 2019; Geraghty et al., 2018; Ben-Ami et al., 2017) while the Oswestry Disability Questionnaire (ODQ) was used in three studies (Chhabra et al., 2018; Hurley et al., 2015b; McDonough et al., 2013). Only one study (Schaller et al., 2016) did not measure functional disability.

2.3.3 Quality

The reviewer examined each of the seven studies that met the inclusion criteria to determine their methodological rigour. The physiotherapy evidence database (PEDro) scoring scale was used to assess the quality of the studies (Table 1). PEDro is a valid tool for assessing the methodological robustness of experimental and quasi-experimental studies. (Yamato et al., 2017) The total score from each of the items is added together and can be utilised as interval level assessment and analysed through parametric statistical measures (Quigley et al., 2019). The quality assessment scale comprises 11 items but only 10 are scored (Yamato et al., 2017). In this study, one point was allocated when a study met a particular criterion out of a possible sum of ten points for the entire instrument. The reviewers considered scores above 5 points as indicative of high methodological rigour, while a score of less than 2 points showed that the study was of low quality. Studies with 2-5 points were deemed to be moderately robust. Table 1 below summarises the PEDro scores for each of the seven studies.

From the table, the average score for the reviewed studies is 8.1, which suggests the methodological efficacy was high across the cohort. While four studies earned eight points each, only one met the entire criteria for quality. Six of the seven studies fell short of the subject

blinding and therapist blinding criteria, which is not unusual since most of the interventions involved an exercise or type of action to which participants or therapists were bound to be privy. The study with the lowest score of the seven did not meet the intervention allocation concealment, in addition to a failure to blind the participants and therapists. Nevertheless, all studies indicated remarkably high quality due to the detailed elaboration of all the steps taken to collect and analyse the data. Risk of bias was not assessed in this review because there was seven studies (less than 10) included to effectively evaluate the Egger's test of publication bias or funnel plot (Al Zahrani et al., 2019).

Table 1: PEDro Quality Assessment (Yamato et al., 2017)

Criteria		Study						
		Amorim et al. (2019)	Ben-Ami et al. (2017)	Chhabra et al. (2018)	Geraghty et al. (2018)	Hurley et al. (2015)	McDonoug- h et al. (2013)	Schaller et al. (2016)
1	Eligibility criteria were specified	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	Subjects were randomly allocated to groups	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	Allocation was concealed	Yes	Yes	Yes	No	Yes	Yes	Yes
4	The groups were similar at baseline regarding the most important prognostic indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	There was blinding of all subjects	Yes	No	No	No	No	No	No
6	There was blinding of all therapists who administered the therapy	Yes	No	No	No	No	No	No
7	There was blinding of all assessors who measured at least one key outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by “Intention to treat”	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	The results of between-group statistical comparisons are reported for at least one key outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	The study provides both point measures and measures of variability for at least one key outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TOTAL PEDRO SCORE		10/10	8/10	8/10	7/10	8/10	8/10	8/10

2.3.4 Effectiveness of Intervention on PA level

In line with the goals of the SR, all studies reviewed focused on specific interventions that promote, enhance and increase PA levels in patients with LBP. Change in PA was, therefore, among the key variables examined by the studies that met the inclusion criteria. It should also be noted that all studies featured the delivery of an intervention through technology/electronic platforms in comparison to conventional LBP management protocols. Amorim et al.'s (2019) study reported a 35% reduction rate of care seeking as a result of reduced LBP and increased PA in the intervention group. This outcome is indicative of a similar degree of intervention efficacy. Telephone-based health instruction delivered over a web application was comparatively more effective than booklet format instructions at PA level. The ETMI in Ben-Ami et al. (2017) had an efficacy level of 2.7 points from baseline compared to the control group in terms of reduction of disability. The ETMI efficacy was attributed to targeting self-efficacy and other barriers to PA. Enhanced self-efficacy resulted from the independence facilitated by the intervention. Chhabra et al. (2018) delivered the treatment through Snapcare, a smartphone application.

Findings suggest that the intervention is significantly more effective, especially in disability reduction compared to conventional treatment comprising handwritten prescriptions and exercise recommendations.

Interventions in Geraghty et al. (2018) consisted of either usual care and an internet intervention or usual care, internet intervention, and additional physiotherapist support via telephone. The findings indicate greater compliance to PA recommendations in the second intervention that included telephone support from a physiotherapist. In Hurley et al. (2015b), the interventions included an individualised walking programme in the group exercise class that were compared to usual physiotherapy. The findings showed significant improvement in

PA across all groups. However, there were no statistically significant differences between the three groups. These findings suggest that the support of a therapist contributed more to increased PA by encouraging participants' accountability.

Schaller et al. (2016) designed a multicomponent intervention dubbed movement coaching. The treatment included small group intervention administered twice during inpatient rehabilitation. This approach was followed by two aftercare phone calls after rehabilitation and a web-based aftercare intervention. The researchers found no significant differences between the intervention and control groups in terms of transport, workplace, and leisure physical activity and pain. Moreover, physical activity declined at similar rates in both groups at the six-month follow-up. These findings differ from studies that found increased PA when technology-mediated interventions were used. In McDonough et al. (2013), participants in the intervention group reported significant improvement in PA. In addition, the group demonstrated a notable change in PA maintenance at 6 months and beyond, which is indicative of the efficacy of the intervention.

2.3.5 Effectiveness of PA Interventions on LBP Measures

Different studies found mixed findings regarding the effectiveness of PA therapeutic interventions on patients with LBP in the reduction of pain and disability. While some recorded significant efficacy levels, others showed no statistically significant improvements. Amorim et al.'s (2019) study on the outpatient physiotherapy department in Sydney found that PA intervention for people with chronic LBP conditions involving health coaching, activity trackers and m-Health over six months was feasible and acceptable by the target population. Patient outcomes from the combination of interventions included significantly lower levels of LBP and disability. In addition, health coaching PA intervention reduced the frequency of care seeking.

Ben-Ami et al. (2017) adopted a multi-centered physical therapy in Israeli health centres comprising two groups: the intervention group and control group. Similar to Amorim et al. (2019), this study collected primary and secondary outcomes to determine the efficacy of the PA intervention. The findings revealed that the PA intervention was effective, such that patients at 12 months recorded a significant decline in LBP levels and overall improved physical health. Chahbra et al.'s (2018) single-blinded RCT in an outpatient spine department in a private hospital analysed data at both the primary and secondary stages. Both the intervention and control groups demonstrated considerable improvement in pain and disability with a greater significant decrease in disability in the intervention group.

The application, Snapcare, facilitated an increase in PA and resulted in clinically meaningful improvement in pain and disability, particularly for patients with chronic LBP. Geraghty et al.'s. (2018) three-armed RCT trial in 12 general practice hospitals consisted of three groups: usual care, internet intervention plus usual care and Internet intervention plus therapist telephone support plus usual care. The PA intervention uses similar outcome measures to assess primary and secondary phases. The findings in both stages suggest that the PA intervention was effective on patients with chronic LBP. In addition, the researchers concluded that the study was feasible of future definitive RCTs, demonstrating the effectiveness of the SupportBack intervention. With or without healthcare, the researchers found that the digital intervention increased access to treatment, which supported behaviour change in LBP patients. Compared to other PA interventions, Hurley et al.'s. (2015b), and likewise, Geraghty et al.'s (2018) PA interventions comprised an assessor blinded prospective RCT with three components. Unlike Amorim et al. (2019) and Chhibra et al. (2018), Hurley et al.'s (2015b) research constituted three groups – the walking programme (WP) biophysical intervention model, the Exercise Class (EC) biophysical model and Usual Physiotherapy (UP). The aforementioned study's overarching aim was to determine the efficacy of the PA intervention

on chronic LBP patients. Findings indicated significant improvement in the ODI, NPRS, Fair Avoidance Beliefs Questionnaire –Physical Activity subscale (FABQ- PA) and health-related quality of life. However, there were insignificant differences between the groups in PA efficacy. In addition, supervised walking, as a PA intervention, was a more effective alternative to the current forms of LBP management. There was also a higher percentage of participants in the WP and UP groups in the moderate category of the IPAQ at 6 and 12 months demonstrating that the PA intervention was effective. McDonough et al. (2013) recommended an EWP PA intervention, with which a feasibility RCT was conducted in primary practice referral lists of two hospitals to evaluate the efficacy of the treatment plan on LBP patients.

The control group, Group 1, received education/advice (E), while the intervention, Group 2, received education/advice and walking with pedometer (EWP). Participants in both the E and EWP reported significantly low LBP, although the latter group showed the greatest improvement. In addition, the EWP group was less likely to continue with physiotherapy at the culmination of the intervention, an outcome that is attributed to treatment efficacy. The pedometer resulted in more sustainable positive outcomes in the long run.

Finally, Schaller et al. (2016) examined the PA effectiveness of movement coaching using a single-centered RCT with two groups: the intervention group and the control group. The PA under investigation comprised of three components: face-to-face contact, tailored telephone aftercare, and internet-based aftercare. In both groups, the PA intervention decreased in the six-months of follow-up. After six months, there were significant differences between the two groups in total PA and LBP.

2.4 Discussion

The overall findings from this review are that targeted interventions for increasing PA are effective in alleviating LBP in patients aged between 18-65 years old. These results are broadly analogous with other extant trials have observed similar outcomes (Gordon and Bloxham, 2016). In this review, six of the studies found statistically significant improvements in PA levels after intervention.

While attrition rates after six months were reported (Schaller et al., 2016), the evidence suggests that behaviour change interventions resulted in higher activity levels beyond 12 months (Amorim et al., 2019; Ben-Ami et al., 2017; Hurley et al., 2015b). The interventions included health coaching and activity tracking, facilitated via coach or therapist follow-up (face-to-face, telephone, or app/web-based). In their study, Gibbs et al. (2018) also reported similar findings, suggesting that these tools are feasible interventions for minimising chronic LBP.

In addition to receiving practical education on the importance of PA for LBP as well as how to adopt the treatment, tracking activity levels enhanced patient outcomes. Studies such as Amorim et al. (2019), Chhabra et al. (2018) and Ben-Ami et al. (2017) that included activity tracking interventions through digital tools or constant contact with therapists showed a higher degree of efficacy, especially in long-term maintenance of treatment effects. Collectively, the findings establish that varied PA interventions are effective for LBP beyond the 12-month mark.

Indicators of efficacy across the studies were recruitment, attrition and adherence and retention rates (Geraghty et al., 2018), increased PA levels, reduced disability, reduced LBP and care-seeking, (Amorim et al., 2019; Chhabra et al., 2018; Geraghty et al., 2018; Ben-Ami et al., 2017, Schaller et al., 2016; Hurley et al., 2015b; McDonough et al., 2013), improved mental and physical health (Chhabra et al., 2018), health-related quality of life (Hurley et al., 2015;

McDonough et al., 2013), self-efficacy and exercise self-efficacy (Hurley et al., 2015; McDonough et al., 2013) and cost-effectiveness (Geraghty et al., 2018). Ben-Ami et al.'s (2017) trial also confirmed the findings of Lawford et al. (2021) and Ferreira et al. (2013), in that therapeutic alliance and collaboration contributed to high intervention efficacy. Geraghty et al. (2018), Ben-Ami et al. (2017), Hurley et al. (2015b) and McDonough et al. (2013) also found positive impacts on fear avoidance through behaviour change principles.

The results also suggest that using multiple components may boost the chances of intervention success in increasing PA and addressing LBP. Similar findings were noted in the study of Kloek et al. (2019), where the authors observed that blended PA interventions were more effective for LBP. It is possible to conclude from Geraghty et al. (2018) and Hurley et al. (2015b) that intervention groups that featured more interventions had higher efficacy rates than those using fewer measures. The outcome was regardless of whether the interventions were delivered via a digital platform. This multi-component hypothesis is also supported by the study of (Schaller et al., 2016), which compared a multi-component intervention with a singular treatment. Moreover, all the studies in the review used multiple interventions for the experimental groups, which yielded positive results.

Geraghty et al.'s (2018) study is unique since the researchers' most successful intervention group included a combination of all the strategy measures in the other six studies. The interventions included usual care (PA education and written information), face-to-face and telephone-based coaching and therapist support and feedback, as well as digital supports. The high efficacy rate of multiple interventions may be attributed to the fact that different PA interventions target specific elements of behaviour involved in encouraging patients to engage in PA (Kloek et al., 2019). For instance, Hurley et al. (2015b) found that multiple PA interventions activate motivation, promote accountability, enable tracking and monitoring, and

serve as reminders. By using multiple interventions, each of these domains of PA is addressed, which contributes to the high efficacy rates in studies that used multiple interventions.

Another key finding relates to how the PA intervention is delivered, and whether the intermediary contributes to the efficacy of the tool. Although assessing the mode of intervention delivery was not part of the SR objectives, it emerged as an important consideration for the study (does the mode of delivery for physical activity intervention determine the success rate?). Studies such as Amorim et al. (2019), Geraghty et al. (2018), and Chhabra et al. (2018), whose control groups included face-to-face and written advice on PA showed that intervention groups receiving digitally mediated interventions had higher success rates.

In these studies, the digital tools included web applications (Amorim et al., 2019; Chhabra et al. 2018; Geraghty et al. 2018) and wearable devices such as the Fitbit (Amorim et al., 2019) and pedometer (Hurley et al., 2015b; McDonough et al., 2013). In all of these studies, groups that received a combination of digitally-enabled interventions showed better outcomes than those receiving just usual care. However, Western et al. (2021) found that high efficacy rates of digital interventions were reported for the higher socioeconomic status populations compared to their more disadvantaged counterparts. This discrepancy should be considered when making recommendations for enhancing PA for LBP.

Arguably, the enhanced success of the digitally mediated tools could be derived by their ability to target multiple aspects of human behaviour change that lead to increased physical activity. For instance, the activity tracker, used as an intervention (Hurley et al., 2015b; McDonough et al., 2013), not only allowed its users to track their progress and maintain high motivation and commitment levels, it also offered an easy and accessible way to save and retrieve activity data and associated changes (Western et al., 2021). As a result, participants in these studies also demonstrated gradual increments (increased) in their PA levels. Technological support also

appeared to mitigate fear avoidance (Hurley et al., 2015b; McDonough et al., 2013) more than was possible through self-monitored interventions. Similarly, constant contact between patients and therapists through phone calls had positive outcomes (Ben-Ami et al., 2017). Thus, it can be surmised that digital interventions were effective in activating and maintaining the behaviour change necessary for increased PA.

A significant observation from the studies was that basing the interventions on behaviour change principles and supportive instruments increased physical activity levels, which ultimately led to decreased pain, disability, and care-seeking behaviour. In this case, the correlation between digital tools and enhanced outcomes can be explained by their ability to activate behaviour change through increased accountability and progress tracking in conjunction with overcoming fear avoidance. Indeed, Hooker et al. (2018) argued that when individuals perceive the positive effects of their behaviour change, they are more likely to continue with the new behaviour in the long term. The digital tools allowed participants to more clearly perceive the relationship between increased PA with better health outcomes. Similar positive effects were evident when patients received telephone or face-to-face follow-up from their therapists.

2.4.1 Strengths and Limitations of Included Trials

A key strength of the trials included in this review was that they met high quality standards according to the PEDro scale. Although the minimum quality score for the trials was set at 5.0 points, most studies had a score of 8.0 and above, with only one scoring 7.0. In terms of limitations, all interventions were implemented in conjunction with other protocols. As a result, it is difficult to determine whether efficacy levels arose purely from the digital-facilitation or were a product of the multiplicity of measures introduced.

2.4.2 Review Limitations

A number of limitations must be considered when interpreting the findings from the current study. The first limitation is that the studies included in this review evaluated multiple digital tools for delivering or facilitating PA interventions for LBP. Undoubtedly, the conciseness of the review would have been significantly improved if all studies examined a particular technological platform or similarly grouped platforms. The multiplicity of the digital solutions, therefore, limits the generalisability of the findings. A second limitation is that the current review does not include meta-analysis and the comparison of PA measures. A third limitation is that the possibility for risk of bias in the included studies could not be examined due to small number of included studies.

2.4.3 Clinical Implications

There is a strong body of evidence establishing the usefulness of digital tools in delivering LBP PA interventions. The studies suggest that the efficacy levels of technology-mediated interventions arise from their ability to induce gradual and sustainable behaviour change. Participants are more likely to change their behaviour by engaging in PA as a well-established strategy for improving LBP and disability outcomes. However, the studies also show that these solutions work as adjuncts to orthodox measures such as face-to-face and written instructions. As such, adopting technological platforms increases adherence due to enhanced tracking and monitoring, provision of feedback and reminders, which act as motivators, and allow close collaboration between therapist and patient.

2.4.4 Further Research Recommendations

Considering that one of the major shortcomings of the reviewed studies relates to the assessment of an amalgamation of treatments for each intervention group, a future study

assessing a single form of treatment (in isolation) would be useful. For instance, a specific intervention delivered only through a digital platform can be compared to traditional interventions to determine their effectiveness for increasing PA and alleviating LBP. In addition, it would also be useful to compare multiple types of digital solutions to determine the most effective in facilitating PA interventions for LBP.

2.5 Conclusion

The findings suggest that both web/technology-mediated interventions resulted in significant improvements in LBP and an increase in PA. Furthermore, some studies suggest that the digitally augmented measures generated more sustainable outcomes in the long run compared to treatment as usual. At this juncture, it is necessary to note that web and technology-based interventions were offered in conjunction with traditional measures including written and face-to-face instructions as opposed to being administered as stand-alone methods.

The consensus among researchers is that PA is an effective adjunct therapy for managing chronic LBP. However, healthcare providers are still grappling with finding effective ways to motivate their patients to increase their levels of PA. Based on this recognition, this systematic review of literature sought to categorise different approaches for promoting PA based on the level of efficacy. The PA methods were grouped according to mode of delivery such as web-based, in-person, written communication, biopsychosocial supports, digital tracking and phone calls. Measures of success included adherence levels, attrition and retention rates, pain alleviation as well as overall physical and emotional health. Each of these categories was examined to discern the intervention's ability to achieve therapeutic goals. Most importantly, the review also considered the most efficacious combination of interventions since multiple tools were assessed in each study sample.

The tentative conclusion at this stage is that these interventions showed a higher degree of efficacy since they represented hybrid treatments that combine multiple types of measures for increasing PA and alleviating LBP. Technology-based treatments often combined one or more traditional methods, which boosted the effectiveness of the treatment regimen. Arguably, the efficacy of the new protocols was enhanced by their ability to motivate participants, track their progress, provide the necessary directives on the move and afford the patients a degree of independence. Moreover, interventions that included tracking or web/telephone support from therapists yielded higher compliance levels than ordinary interventions without follow-up. In this case, it is possible to conclude that digital tools provided a supportive framework for triggering and maintaining behaviour change and improved pain and disability outcomes among patients with LBP. A future study comparing technology enabled interventions for NSLBP would be particularly useful as the world increasingly shifts toward a digital modus operandi in fulfilling many traditional day-to-day activities.

Chapter 3: The Process of Developing a Web-Based Intervention for Self-Management of Low Back Pain (LBP) in Nurses

3.1 Introduction

The SR in the previous chapter outlined the importance of the use of digital health technologies such as web applications, websites and phone applications for promoting PA and behavioural change to improve health outcomes in patients with LBP. Importantly, it highlighted the importance of using theory-driven and evidence-based interventions to support behavioural change interventions; however, none of the aforementioned studies have been implemented in the nursing population. The results of the systematic review also identified a gap in the literature on PA interventions for nurses with LBP. Few studies have tested the use of digital interventions to support the self-management of LBP; little focus has been paid to the potential use of the biopsychosocial model to inform management in view of the relationship between behavioural, psychological and social factors that mediate the future determination of pain, disability and subsequently, quality of life. Therefore, incorporating PA interventions based on biopsychosocial approaches and self-management strategies has a positive effect on LBP outcome measures, but this approach was not previously considered in interventions for occupational LBP in nurses. This study aims to explore the feasibility and acceptability of a web-based intervention for the self-management of LBP in nurses. The rationale for the type of delivery (web-based intervention) is outlined in Chapter 1. This chapter demonstrates how the Medical Research Council (MRC) frameworks has assisted in developing theory web-based interventions and the process that has been used to reach the final stage of intervention content development. A description of the web-based intervention content is explicitly outlined in this chapter.

3.2 MRC Stage Guidelines for Intervention Development

In 2006, the MRC published guidelines for developing and evaluating complex interventions (Craig et al., 2008). This has provided an influential framework of guidance on the development and evaluation of a complex intervention, thus equipping medical researchers with a comprehensive framework (Senn et al., 2013; Craig et al., 2011; Craig et al., 2008).

Concerns about implementing a complex intervention should start with a development and feasibility design phase by considering barriers that must be overcome to enhance successful implementation, noting that neglecting adequate development in the piloting of an intervention will result in weaker interventions that are difficult to evaluate and less likely to be value implementing (Craig et al., 2011). The MRC framework consists of four phases: (1) development, (2) feasibility / piloting, (3) evaluation and (4) implementation (see Figure 4). Each phase is essential; however, the phases may not always follow a linear chronological sequence. Rather, the phases can be implemented iteratively and simultaneously (Craig et al., 2011). The MRC updated guidelines in 2021 to cover the new challenges in complex intervention research that were identified and realised in previous guidelines (Skivington et al., 2021). However, the web-based intervention in this study, developed in 2019, aligns with the 2011 MRC guidelines for developing and evaluating complex interventions that were available at that time. This thesis focuses on the first two phases of the MRC guidelines due to the limited timescale/constraints involved with this study; specifically, the development phase (Chapters 1, 2 and 3) and the feasibility/piloting phase (Chapters 5, 6 and 7) conclude with a discussion, recommendations for future research and conclusion (Chapter 8); see Table 2. The MRC guidelines will provide researchers with guidance on how to develop and evaluate a complex intervention through the proposed framework (Table 3).

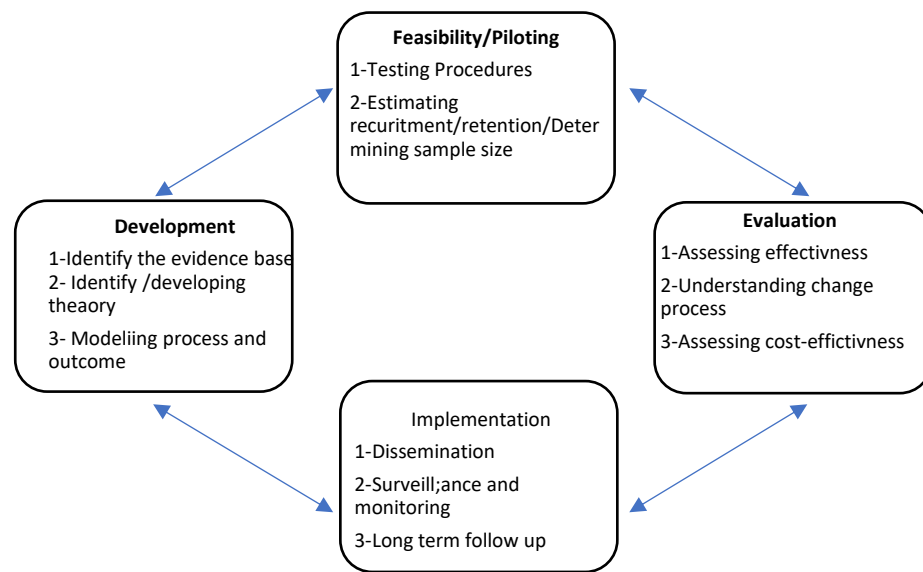


Figure 4: The MRC framework (adapted from Craig et al., 2011)

Table 2: Structure of Thesis Chapters in relation to the MRC framework

MRC Framework	Identify evidence-based		Identify Theory		Testing Research Process	Recruitment Rate and Adherence	Testing Intervention process and Acceptability	
Thesis Chapter	Chapter 1 Introduction and Background	Chapter 2 Systematic Review	Chapter 3 Intervention Development	Chapter 4 Methods and Methodology	Chapter 5 Quantitative Result	Chapter 6 Qualitative Result	Chapter 7 Process Evaluation	Chapter 8 Discussion and Conclusion

Table 3: Thesis Methodology in relation to Intervention Development according to MRC Guidance

Phase 1- Developing a Complex Intervention	1- Identify the evidence base - Identify the existing evidence-base and international clinical guidelines for interventions of LBP in different target populations and contexts. - Review the evidence that supports and enhances self-management approaches for LBP in different populations. - Review current digital interventions (such as eHealth, web-based and mobile app services) in the literature for the self-management of LBP in different contexts and different populations. - Review recent evidence and international clinical guideline recommendations for LBP interventions for nurses and a similar target population as well as identify what has been done previously along with any gaps in knowledge in the literature. - Review recent international clinical guidelines related to web-based content and self-management behaviours for LBP in nurses. - Identify the biopsychosocial intervention model as a recent intervention for the self-management of LBP within different populations. - Evaluate a new intervention strategy based on cognitive behavioural approaches such as physical activity interventions by conducting a systematic review of the relevant studies to determine any knowledge gaps in the literature. 2- Identify and develop theory - Review psychological theories on behavioural change. - Identify and develop a potential behavioural change theory related to the selected determinants of health behaviours for nurses with and without LBP to change their behaviours and lifestyle to alleviate episodes of LBP symptoms and promote healthy lifestyles. 3- Model the process and outcomes Modelling the process and outcomes of the intervention content before a full evaluation provides an important research strategy information about the design of both quantitative and qualitative studies among nurses with LBP. - Develop a web-based intervention programme that adopts many processes before a full version is created. This includes identifying suitable objectives and outcomes measures and ensuring strict standardisation protocols.
Phase 2 Assessing Feasibility and Piloting	- Evaluate the acceptability and usability of the web-based intervention, including intervention delivery, recruitment rate, retention rate and appropriateness of selected outcome measures, before designing a full trial constituting the primary objectives of this thesis.

3.3 Importance of Theories of Intervention Development

Theories are an essential part of research design. They can provide guidance for the development stage and produce clarifications and predictions to determine the relationship between individuals (West and Brown, 2013). MRC guidelines recommend incorporating theory when designing complex intervention (Craig et al., 2011). Theory-driven interventions improve outcomes and provide provisional explanations for high-quality interventions when key related factors were addressed (Heath, Cooke and Cameron , 2015). Mceachan et al. (2008) highlighted three important functions of including theory in the development of behavioural interventions: 1) improve knowledge to explain theoretical constructs or predict behaviours to give emphasis to the necessity of the intervention, in other words, the ‘what of the intervention’, 2) theory may help in the selection of effective approaches for changing these theoretical constructs, or the ‘how behaviour may be changed’, and; 3) theory is essential to evaluate and explain the changes in the interventions and the ‘why change has occurred’. Incorporating theories and related techniques into an intervention could help change behaviours and improve long-term adherence (Dziedzic et al., 2014). Behaviour can be defined as “any response a person does to an internal or external event and the resulting action can be measurable or indirectly measurable” (Michie, Atkins and West, 2014). Undergoing behavioural change is not easy; attempts at behavioural change become more effective when interventions are based on theories of behavioural change (Cane et al., 2012). Complex interventions are designed to improve health outcomes by altering self-management behaviours that include many interaction components and several outcomes, as well as a number of behaviours between those who deliver and receive interventions (Craig et al., 2008; Hurley et al., 2015a). Theories used within behavioural change interventions aim to answer the how, when and why questions of a specific behaviour. They provide an essential understanding of the behaviour change process of the intervention and focus on possible methods to alter this process (Procter et al., 2014).

Behaviour change theory, which includes behaviour change techniques (BCTs), is the most common behaviour change in practice, focusing on the intention behaviour gap that could have a significant impact on adherence to exercise and lifestyle behaviours, such as physical activity (Baretta et al., 2019; Geraghty et al., 2018; Sniehotta, Scholz and Schwarzer , 2005).

Self-management is defined as “the ability to manage the symptoms, treatment, physical and psychosocial consequences, and lifestyle changes inherent in living with a chronic condition ” (Barlow et al., 2002). The essential goal of self-management is to enhance a positive health behaviour (Marks and Allegrante, 2005). Interventions that apply group interventions and incorporate an underpinned theory should focus on individual behaviours within the context of a group setting to support an individual’s needs (Keogh et al., 2015). Studies on LBP populations and therapies varying from psychologically informed physiotherapy to behavioural interventions have reported only small to moderate effects because LBP populations may need a theory-driven intervention that determines the mechanism underlying major barriers to recovery (Raftery et al., 2013). Therefore, theoretical frameworks have been used in the development and delivery of this LBP self-management web-based intervention program for the nursing population with and without LBP.

There are a number of theoretical frameworks that have an important effect on the healthcare interventions for individuals. These theories are derived from psychological approaches, and they include aspects such as self-efficacy, knowledge, attitude, motivation and goal setting, which could enhance a patient’s reaction and adherence to treatment recommendations (Keogh et al., 2015; Hurley et al., 2015a; Irvine et al., 2015b; Raftery et al., 2013; Cane et al., 2012). Many recognised theories have been reviewed in this thesis such as SCT (Bandura, 1986), the Transtheoretical Model of Change (Prochaska and Velicer, 1997), the Theory of Planned Behaviour (Ajzen, 2011) and the Behaviour Change Wheel (BCW; (Michie et al., 2014).

However, SCT theory was selected for the development of the web-based intervention in this thesis.

In addition, a number of theories relevant to the domain of technology acceptance have involved the development of frameworks for evaluating the usability and usefulness of specially designed technologies. It has been argued that e-Health technologies require careful communication and coordination between healthcare professionals and end users, and that the lack of human interaction within technology may explain usability problems and low levels of engagement (Van Gemert-Pijnen et al., 2011). Therefore, this thesis has adopted TAM (Davis, Bagozzi and Warshaw, 1989). The following sections will focus on SCT (which relates to the content and purpose of the intervention in changing behaviour), TAM (which relates to the participants' views and interactions with the web-based intervention) and how they are utilised in the development of the web-based intervention.

3.3.1 Social Cognitive Theory (SCT)

SCT is a contemporary theory of learning that focuses on the reciprocal interaction between three sets of affects: personal, behavioural and social environment (Bandura and Walters, 1977). It provides the opportunity for learning knowledge, strategies, skills, beliefs and attitudes by establishing interactions with other individuals to learn about usefulness, appropriateness, and subsequently, behaviours (Schunk, 2012). SCT plays a major role in the self-regulatory process (Bandura, 1986). Individuals regulate their behaviours to adapt to their internal goals and standards as they work on target tasks and assess their progress or change their strategies against their goals (Schunk, 2012). Research has examined the role of different symbolic processes that are key to the social cognitive process for motivation and learning. These symbolic processes include self-efficacy, goals and self-evaluations of progress, values,

outcome expectations and social comparisons (Schunk, 2012). Self-efficacy is the key construct in this theory and has been hypothesised to affect behaviours and environments (Bandura, 1986). Self-efficacy is defined as an individual's level of ability to achieve a target behaviour in specific circumstances and their confidence in performing the target health behaviour (Schunk, 2012; Bandura, 1986). It is a key determinant of an individual's self-regulation, motivation, learning and achievement (Schunk, 2012). Individuals acquire self-efficacy information from physiological and emotional indicators, such as stress and anxiety (Bandura et al., 1999). In the domain of self-management, SCT covers theoretical pathways for understanding and promoting self-management behaviours (Sun and Jiang, 2021; Allegrante, Wells and Peterson, 2019). Importantly, self-management relies heavily on self-efficacy to accomplish tasks and overcome self-doubt (Bandura, 1986). SCT has been successfully used in the development, delivery and implementation of self-management interventions for LBP and has positive effects on pain and intensity (Sun and Jiang, 2021; Du et al., 2020; Shojaei et al., 2017; Du et al., 2017,). In the digital health context, empirical research has suggested that self-efficacy is positively associated with the use and acceptance of digital health tools, which could increase individuals' intention to perform the target behaviour and improve clinical outcomes (Sun and Jiang, 2021; Balapour et al., 2019; Du et al., 2017; Johnston et al., 2013). Therefore, SCT was selected for this study to develop a web-based intervention programme in which self-management skills can be supported and promoted in the nursing population to ensure that they can reduce or prevent LBP.

3.3.2 The Technology Acceptance Model (TAM)

With the rapid development and innovation of information technology (IT) in healthcare systems, many studies have established frameworks for evaluating and examining the use of developed and implemented technology. The theoretical framework of technology in this thesis

is based on TAM theory (Davis et al., 1989). The goal of the TAM is to provide a framework for examining how different considerations affect an individuals' use and acceptance of a new type of technology, such as web-based interventions (Davis et al., 1985). TAM is a popularly implemented framework for the prediction of users' technology acceptance in various domains, specifically healthcare. TAM has been used in previous studies related to the application of technological innovations for medical interventions (Drehlich et al., 2020; Gance-Cleveland et al., 2019; Irvine et al., 2015b; Wang et al., 2018; Rahimi et al., 2018). TAM provides a description of the determinants of digital technology acceptance in different contexts and cultural settings (Abdullah and Ward, 2016; Sun and Jiang, 2021). It can also explain individual behaviours over a broad scope of end-user populations (Ladan, Wharrad, and Windle, 2018).

Essentially, TAM suggests that computer utilisation is based on the intention to use and the extent to which an individual accepts a new technology (Davis et al., 1989; Figure 5). TAM is based on two major concepts: perceived ease of use (PEOU) and perceived usefulness (PU; (Davis et al., 1989). PU is defined as “the degree to which an individual believes that using a particular system would enhance his/her job performance”, whereas PEOU is “the degree to which an individual believes that using a particular system would be free of physical and mental effort” (Davis et al., 1989). According to TAM, the usage of technology is determined by behavioural intention, which is affected by PU, PEOU and attitude towards the technology (Ladan et al., 2018). TAM can explain the perception of utility and the ability to effectively utilise technology, which have been demonstrated to be the core driving forces shaping the adoption of digital interventions in healthcare (Nguyen et al., 2020; Rahimi et al., 2018; Holden and Karsh, 2010). Although TAM has been useful in explaining technology acceptance, some limitations of this model have been determined. First, external factors such as social impacts on technology adoption are not considered in TAM (Wang et al., 2018). Second, TAM has also been criticised for only giving general information on use intention while it is able to explain

user behaviour across a broad range of end users and user populations (Koivumäki, Ristola, and Kesti, 2008). Despite the importance of recognising the social factors that influence the adoption of web-based interventions, the primary objective of this research is to investigate the behavioural intentions that could enable nurses to use and accept the proposed web-based intervention programme for the self-management of LBP.

In this study, the TAM framework is used to explain the extent to which technology contributes to the feasibility of the web-based intervention for nurses with and without LBP by examining the nurses' usefulness and usability rather than as a theoretical framework. In addition, TAM was used to guide the analysis of most of the qualitative data in this study, as will be explained in Chapter 6. By using TAM, it became clear that the acceptance of a web-based intervention based on PU and PEUS revealed nurses' intentions to use the web-based intervention and enable the actual use of it. Thus, the **usefulness** of a web-based intervention programme is defined as the level to which nurses believe that using such a programme would enhance their ability to manage and prevent back pain. This also includes any comments or feedback related to present and future outcomes and recommendations to enhance usability.

Based on TAM, when potential users think that a specific application may be beneficial, they might also think it is difficult to utilise it and that any benefits gained from its usage are outweighed by the effort required to use this application (Davis et al., 1989). Therefore, **usability** is another factor that affects PEOU. Accordingly, in this study, the definition of usability has been delineated as the level to which nurses think that the use of a web-based intervention programme would require minimal effort and easy navigation. Additionally, any negative or positive feedback associated with any content, media characteristics or technical problems that restricted nurses from easily navigating the web-based intervention programme is categorised under usability.

Other key factors that influence the success of technological systems are ***user perception*** and ***engagement*** with the technology (Cruz-Benito et al., 2015; Attfield et al., 2011), which were also investigated in this study. The success of digital technology depends on its continued use and its relevant implementation on a daily basis rather than users' initial acceptance of use (Lehrer, Constantiou and Hess, 2011; Kim, Chan, and Chan, 2007). Additionally, users' attitudes and behavioural intentions with digital technology enable them to select when, where and how they engage with and control their activities (Kim, Kim and Wachter, 2013). Therefore, it is essential to explore the level of engagement among nurses with or without a history of the LBP with the web-based intervention programme to improve and develop digital interventions in the KSA, as well as their PU. Examining patterns of behaviour and quantifying engagement allows researchers to identify the extent to which users are interested in particular aspects or content, as well as whether these aspects are utilised correctly (Cruz-Benito et al., 2015). Data regarding engagement will also allow technology designers and developers to enhance user acceptability, performance, interest and feedback.

Although there are conceptual similarities between technology acceptance and technology engagement, their definitions, conceptual bases and applications differ (Kim et al., 2013). In general, acceptance implies the degree to which a person or organisation chooses to utilise something, whereas engagement refers to the extent of involvement, retention and intrinsic interest in something (Pagani and Mirabello, 2011). Engagement is a phenomenon that manifests in the form of energy, involvement and efficiency that is defined conceptually as a behavioural flow with no deliberate attitude, such as focus, curiosity, attention and/or intrinsic interest (Kim et al., 2013). In this study, engagement is defined as a nurse's experience with a web-based intervention programme such as the participants' willingness to repeatedly use the web-based intervention programme as intended, repetition experiences, recommendations to

others and any suggestions for improvement. Therefore, examining the nurses' views on using web-based intervention programmes for the self-management of LBP, specifically regarding PU and PEOU, would indicate the **acceptability** of web-based intervention programmes.

In summary, TAM was utilised in this study to guide the identification of web-based intervention programme acceptance among Saudi nurses by exploring its usability and usefulness. Importantly, TAM was used to guide the study's analyses, especially qualitative analysis. TAM revealed that, to promote the acceptance of the web-based intervention programme, PU and PEUS are key factors that disclose participants' intention to use the WBI-BACK and would result in actual use of it. Thus, usefulness and usability are key factors to be discussed in the results of this research to promote the feasibility of a web-based intervention programme for nurses. Additionally, investigating how participants engage with the web-based intervention programme would provide a further understanding of their acceptance and the usability of this digital tool, as well as determining whether this tool can be transferred and used in different contexts.

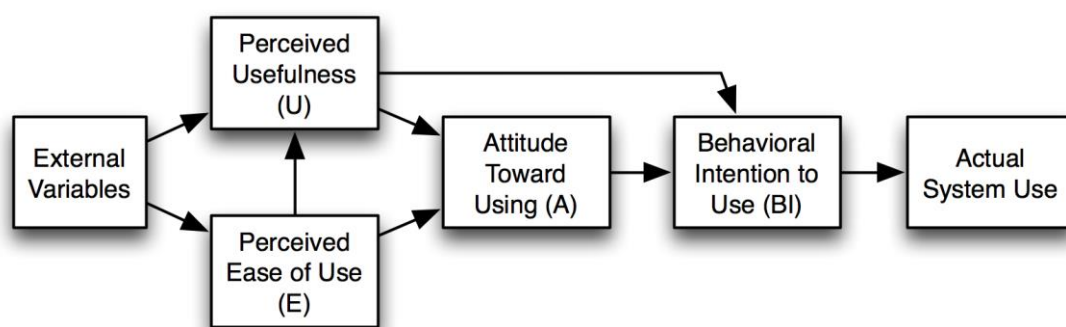


Figure 5: Technology Acceptance Model (TAM; (Davis et al., 1989))

3.4 Translating Theory and Evidence

In the previous sections, the MRC guidelines for the development of the web-based intervention programme were illustrated; subsequently, potential theories in relation to the web-based intervention for nurses with and without LBP were identified. In this section, the guidelines for developing a web-based intervention programme are reported.

3.4.1 Identifying Behavioural Determinants, Intervention Objectives and Functions

SCT is the most often employed behavioural change theory in individual-based self-management intervention programmes, especially for the LBP population (Keogh et al., 2015; Hurley et al., 2015a). In this thesis, the overall aim of the web-based intervention is to support nurses with and without LBP to become skilful in self-managing their LBP to decrease pain and related disability through the use and self-monitoring of behavioural strategies to improve self-care and LBP prevention behaviour. The web-based intervention utilises a self-tailored cognitive behavioural method modelled on SCT, and this has been shown to have a significant effect on behaviour in digital interventions (Welch et al., 2018; Irvine et al., 2015b; Webb et al., 2010). The specific objectives of the web-based intervention programme for the self-management of LBP are to: (1) promote physical activity, (2) use specific LBP exercises to alleviate pain and disability, (3) promote ergonomics intervention and; (4) improve mental health, wellbeing and healthy lifestyles (Figure 6 ; Hutting et al., 2019; Hurley et al., 2015a; Geraghty et al., 2015; Irvine et al., 2015b). Based on behavioural intervention objectives, four determinants of self-management behaviour were selected: self-efficacy, knowledge, skills and motivation (Hutting et al., 2019; Hurley et al., 2015a; Irvine et al., 2015b; Johnston et al., 2013), as outlined in Figure 7. The selected determinants were linked to the change in objectives and translated into a range of web-based intervention functions (Table 4). Applying

SCT to the participants in this research could improve their adherence to exercise, goal setting, self-monitoring and action planning (Keogh et al., 2015). Consequently, it could help nurses self-manage their LBP. As the potential for the web-based intervention to result in the target change of improved self-management behaviour is doubtful (Courneya, 2010), the contributing assumptions of SCT in behavioural change among nurses with and without LBP will be explored in this feasibility study and will further inform the design of a full trial.

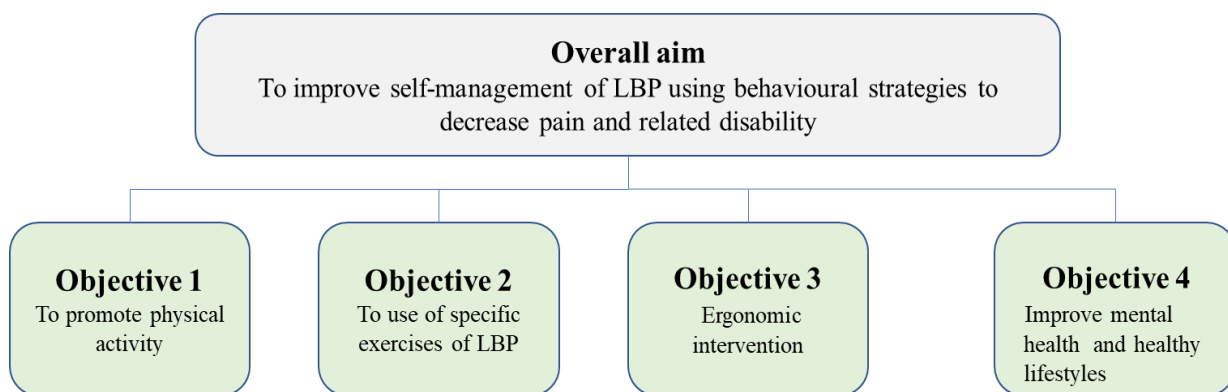


Figure 6: Overview of Objectives of Web-based Intervention Programme

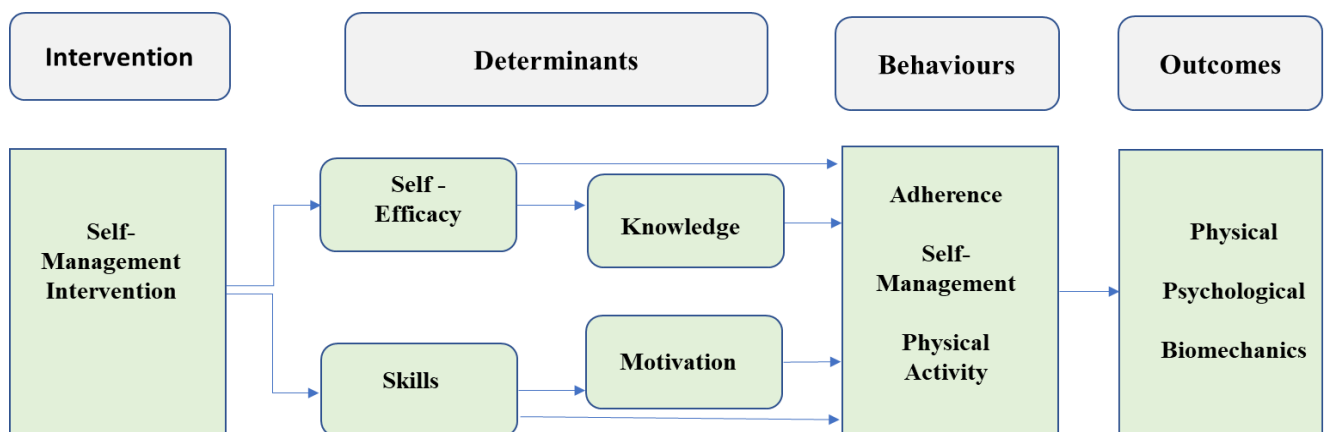


Figure 7: Process Map of Behaviour Change for Self-Management Intervention

Table 4: Intervention Objectives Mapped to Determinants of Self-Management Behaviour

Desired Objectives	Determinants of Self-Management Behaviour			
	Knowledge	Skills	Self-Efficacy	Motivation
1- Promote Physical Activity (PA)	- Develop an understanding of the recommended levels and types of PA for adults. -Develop the benefits of PA. - Develop an understanding of how to perform different types of selected PA.	- Develop skills to participate in different levels and types of PA. - Develop skills to set weekly goals for engaging in different types of PA. - Develop skills to monitor progress in promoting PA.	- Improve confidence in the ability to perform and engage in the selected types of PA. - Improve ability to cope with challenges encountered in participation. - Reduce fear of movement related to engaging in PA. - Develop positive thoughts and emotions related to PA.	- Increase autonomous motivation to stay physically active. - Increase motivation to cope with challenges encountered in PA participation. - Increase motivation by sharing knowledge of PA with others.
2- Use of Specific Exercises for LBP	- Develop an understanding of the rationale of exercise therapy in preventing and managing LBP. - Develop an understanding of the different types of exercises. - Develop an understanding of how to perform selected exercises.	- Develop skills to participate in different types of exercises. - Develop the ability to observe pain condition and select an appropriate exercise. -Develop the ability to monitor and incorporate the effects of selected exercises in daily life.	- Improve confidence in the ability to perform and engage in selected types of exercises. - Improve ability to cope with challenges encountered in participation. - Reduce fear of movement-related engagement in particular exercises.	- Increase autonomous motivation to do the exercises regularly. - Increase motivation to cope with challenges encountered in exercise participation. - Increase motivation by sharing knowledge of exercises with others.

			- Develop positive thoughts and emotions related to exercises.	
3-Ergonomic Intervention	- Develop an understanding of the benefits of using ergonomics in workplace area. - Develop an understanding of mechanical risk factors for back injuries. - Develop an understanding of occupational interventions for back injuries among nurses.	- Develop skills to ensure good body mechanics and perform proper manual handling techniques. - Develop skills to maintain good body posture.	- Improve confidence in ability to ensure good body mechanics and perform proper manual handling techniques. - Improve ability to cope with challenges encountered in lifting and transferring patients.	- Increase autonomous motivation to share the positive experience of maintaining proper body posture and manual handling techniques. - Increase motivation to cope with challenges encountered in lifting and transferring patients.
4 - Improve Psychological Wellbeing and Healthy Lifestyles	- Develop an understanding of cognitive behavioural therapy for LBP. - Develop an understanding of relaxation techniques and stress management. - Develop an understanding of healthy lifestyle guidelines.	- Develop skills to perform relaxation techniques and stress management. - Develop skills to maintain a healthy lifestyle.	- Improve confidence in ability to control pain and related fear and distress. - Improve self-efficacy in ability to monitor healthy lifestyle behaviour. - Avoid passive coping and develop a sense of control.	- Increase autonomous motivation to self-manage pain condition. - Increase motivation to reduce fear associated with back pain. - Increase motivation by following healthy lifestyle guidelines.

3.4.2 Identifying the Challenges for Developing a Web-based Intervention Program

Digital interventions such as interactive websites, mobile apps and short message services (SMS) can enhance health care outcomes by supporting behaviours involved in the self-management of diseases. For such interventions, there is a special need for consideration in designing and developing digital interventions. Michie et al. (2017) highlighted many challenges involved in developing and implementing a digital behavioural change intervention. These challenges are engagement, pace, efficiency and theory, which are addressed in this thesis (see Table 5). Additionally, TAM was considered in the design of the web-based intervention programme.

Table 5: Challenges in Developing Digital Intervention

Topics	Challenges	Management
Pace and Efficiency	- Fast technology innovation and iterative development make it necessary to continuously update and accept interventions. - Efficient and continuing relationships between intervention developers and end users are needed to promote the technology's implementation and evaluation.	- Develop and adopt an easy-to-use programme that is accessible by all nurses, such as a web-based intervention programme or mobile phone application (app). - Provide support to adopt a new digital intervention. - Ensure an efficient relationship between the researcher and nurses through the initial interview. - Ensure the introduction to web-based intervention is appropriate and the intervention tasks are clear.
Engagement	- Engagement with a digital intervention has a limited effect on behaviour change.	- Identify and develop an easy-to-use programme and minimise complexity. - Encourage engagement by adding creative elements into the web-based programme such as photos, videos and exercises. - Provide opportunities for interaction between the researcher and nurses by weekly reminder emails to encourage engagement.
Theory	- There is a lack of knowledge regarding the behavioural mechanism explaining how and why a digital intervention is effective.	- Use features of behavioural change theory (SCT and TAM) in the design and development of the web-based intervention.

3.5 Intervention Development Process

In the previous sections, the guidelines for developing a web-based intervention programme were illustrated and reported. In this section, the development process for the web-based intervention programme is demonstrated.

3.5.1 Introduction

A rigorous developmental method is essential for developing a high-quality digital intervention. The Agile Methodology (Boyle et al., 2006) was used to develop and evaluate a web-based intervention programme for the self-management of LBP (WBI-BACK) in nurses. The Agile method is a high-quality, robust and flexible digital framework programme that has previously been used for e-learning (Boyle et al., 2006; López-Alcarria, Olivares-Vicente and Poza-Vilches, 2019) and intervention development in the area of workplace health (Blake, Somerset and Evans, 2020b; Blake and Gartshore, 2016) and in public engagement activities (Todhunter, 2017). It reveals a principal set for establishing a software programme in collaboration with organised functional groups (Beck et al., 2001). The main objective of the Agile approach is to develop programmes that tap into an individual's motivation by promoting the working environment and offering the support they need (Beck et al., 2001). The Agile approach has been widely supported by engineering societies, where development and evaluation happen in parallel and in synergy until the results have been optimised (Hekler et al., 2016).

The process of developing the WBI-BACK intervention programme was carried out by a PR under collaboration among the principal supervisors and software developers, in which the researcher was responsible for the conceptual design of the theory web-based intervention content and the software developers provided the technical expertise to build the digital

package frameworks of the WBI-BACK intervention programme. The Agile approach allowed the collection of important assumptions about the problem, objectives and solutions, resulting in the use of an effective plan to evaluate the programme's development following updates and feedback from the reviewer. There are three (primary) important functions to be covered in the development process: analysis of need, designing and developing stage and the testing stage (Boyle et al., 2006). Therefore, the development of the WBI-BACK intervention programme based on co-design strategy and user experience testing and its three stages are reported separately in the following sections (see Figure 8):

- **Stage 1 (stakeholder consultation)** explored the perceived need for the WBI-BACK intervention programme and types of resources through stakeholder consultations.
- **Stage 2 (content development and prototyping)** involved the design and development of the WBI-BACK's content, as well as a software online version of the programme.
- **Stage 3 (iterative peer review)** carried out the review, evaluation and pilot test for the WBI-BACK programme, which led to final digital package production and refinement.

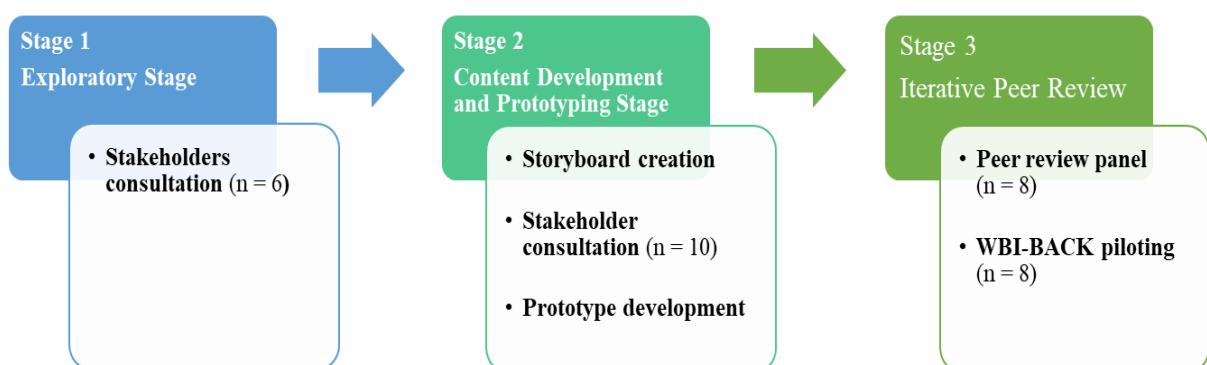


Figure 8: The Three-Stages of the Agile Development Process

3.5.2 Stage 1: Stakeholder Consultation

Introduction

When developing a digital intervention, it is essential to involve a team of stakeholders with expertise in different fields to guide the development process. Stakeholders are actors who play many important roles, from ideation to operationalisation, in the development of digital health technology (Carr et al., 2009). The perspectives of stakeholders' participation are important to reflect their values, goals and knowledge of the development of digital technologies (van Gemert-Pijnen et al., 2011). These stakeholders should be included in the early stages of the development phase to increase the probability of a positive impact on health and outcome quality (Hamid and Sarmad, 2008).

Objectives

The objective of stakeholder consultations is to explore the views, attitudes and knowledge of stakeholders towards LBP management among nurses and to determine their views towards digital health intervention.

Method

A stakeholder consultation was held in January 2019. This involved consultations with healthcare and academic professionals during the development process of WBI-BACK, as a pragmatic approach was adopted. Stakeholders were identified through professional networks in the KSA and UK and purposively invited to be involved in the consultation. Six stakeholders (4 female, 2 male) comprised of 2 physiotherapists, 2 nurses, 1 health educator and 1 health psychologist were contacted twice by email to discuss their personal and professional experience. The PR used two main questions to guide the exploratory stage (Table 6). Each stakeholder produced notes related to the main questions, and the key points were highlighted.

Results

Six stakeholders who had expertise in pain management, rehabilitation, workplace health, public health, digital learning and health psychology sent in their responses electronically by email. Stakeholders' feedback towards the development of the WBI-BACK programme was summarised, and the key points from their responses are outlined in Table 6.

Table 6: Stakeholders' views towards the Development of the Web-based Intervention Programme

Questions	Stakeholders' Responses
1- What are the main issues around managing LBP among the nursing population?	- Stakeholders agreed that it is important to include self-management strategies for LBP among nurses. - Stakeholders suggested including exercises and ergonomic interventions as important intervention strategies for LBP among nurses. - Stakeholders suggested including some psychological interventions for LBP self-management among nurses. - Stakeholders stated that online material should be suitable to the nursing profession and relevant to nurses' back problems resulting from their work activities and daily life.
2- What are your perceptions towards digital health interventions for the self-management of LBP?	- Stakeholders were very positive about using the web-based intervention for the self-management of LBP among nurses. - Stakeholders had a positive attitude towards the new health innovation for nurses working in the KSA as the first digital health tool for LBP in the KSA. - Stakeholders agreed to include interactive elements of exercises, such as photos and videos, to increase participation. - Stakeholders preferred to design an easy and flexible format for a web-based intervention programme for nurses to encourage their engagement. - Stakeholders suggested that the web-based intervention programme should have an interactive user interface and effective navigation. - Stakeholders had concerns regarding the lack of technical skills among some nurses. - Stakeholders were concerned about the technical support for the web-based intervention programme.

3.5.3 Stage 2: Content Development and Prototyping Stage

Objectives

This stage aimed to develop the ‘storyboard’ for the WBI-BACK intervention programme, assess the content through stakeholder consultations and finally develop an online version of the WBI-BACK intervention programme.

Method

In this stage, the content for the WBI-BACK intervention programme was drafted, by a process called ‘storyboarding’. A storyboarding was undertaken over a period of two months to establish the key messages, design and content for the WBI-BACK intervention programme. The development of a ‘storyboard’ content draft, followed by draft content for an online version of the programme following stakeholder consultations. Initial content was drafted based on stakeholders’ feedback in the exploratory stage, behavioural intervention objectives (Table 4) and the key topic areas based on the evidence-based information and international guidelines around the management of LBP. These topics included digital interventions for the self-management of LBP (Geraghty et al., 2018; Chhabra et al., 2018; Irvine et al., 2015; Hurley et al., 2015a), exercise (Shiri, Coggon and Falah-Hassani, 2018; Searle et al., 2015), PA (Amorim et al., 2016; Sokunbi et al., 2016; Hurley et al., 2015b; Tucker, Welk and Beyler, 2011), ergonomics (Rogers, Buckheit and Ostendorf, 2013; Waters, 2010), psychological wellbeing (Pincus and McCracken, 2013) and interventions for LBP in nurses (Van Hoof et al., 2018; Shojaei et al., 2017; Dawson et al., 2007). The presentation of initial draft content included specifics of interactive elements such as images, videos, activities and quizzes, to increase engagement and suitable resources (Clark and Mayer, 2016; Cook et al., 2010). The

initial draft content was reviewed by the supervisors (PH and HB), who had expertise in physiotherapy, self-management of chronic conditions and health behaviour change, and then the feedback was considered.

Applying the Agile approach allowed reviewers to ask for feedback (Boyle et al., 2006). Once the written storyboard content was finalised, further stakeholder consultations were conducted to review the storyboard content. These consultations included 10 stakeholders (5 female, 5 male) who were experts in healthcare and education. Specifically, this group included 5 physiotherapists, 3 nurses, 1 health psychologist and 1 health educator. Involving many stakeholders leads to the production of high-quality materials and well-designed resources aligned with user needs, generating positive results (Ferguson et al., 2016). Stakeholders were asked to review the WBI-BACK content and provide their feedback using a structured questionnaire form (Figure 9) that was returned by email. The questionnaire form was developed by the PR and reviewed by the principal supervisors (PH and HB), and the question items were reviewed by two stakeholders prior to use. Stakeholders' feedback was addressed in the final storyboard content draft.

Following stakeholder comments, the online content of the WBI-BACK programme was developed using Xerte. This is an open-source software programme developed by the University of Nottingham in the UK that is authorised for use for learning purposes. Xerte is free from the Xerte community website (<https://www.nottingham.ac.uk/xerte/index.aspx>). It is a tool that can be utilised to create and develop media with accessible and interactive content, without the need for technical or digital programming information (Blake et al., 2020a). The WBI-BACK online content was enhanced by liaising with the Health E-learning and Media (HELM) team at the University of Nottingham in the UK, which produced a systematic approach to digital development. The HELM team supported the development of the prototype of the WBI-BACK intervention by providing technical training in the development process.

The initial prototype of the WBI-BACK content was produced by the PR and reviewed by the supervisors (PH and HB). The supervisors reviewed the entire digital package in terms of appropriateness of layout, videos, images and web links as well as clear text and consistent resources. The final prototype was then developed and made ready for use.

Figure 9: Stakeholder's Questionnaire Form

1. What is your first impression from the WBI-BACK programme content?
2. Was the content that was offered provide a sound level of accessibility for you?
3. Did the content address the key points in managing low back pain among nurses?
4. Was the content being offered by the WBI-BACK programme, well-designed and complete with an appropriate level of detail?
5. What other content do you think could be included in this intervention programme?
6. Was the layout of the WBI-BACK intervention programme easy to understand?
7. Was the interactive element effective and reflective?
8. Were the images effective and authentic?
9. Which of the following modules in the WBI-BACK programme do you think need improvement and how?
10. Do you have any other comments regarding the WBI-BACK programme?

Results

The overall content development process lasted from February 2019 to June 2019. The overarching aim of the WBI-BACK intervention programme is to promote self-management behaviour in treating LBP among nurses with and without LBP using a specific self-management strategy which was explained in section 3.5.1). Therefore, the development of a storyboard provided evidence-based guidelines for the self-management of LBP in nurses and signposting in six broad areas, including (1) **education** to improve knowledge about occupational LBP and its consequence predisposing factors and management, (2) **exercise** to

strengthen the back, abdominal and core muscles along with flexibility of lower limbs through demonstrations based on images and videos, (3) **PA** to promote fitness levels according to international guidelines, (4) **ergonomics** to improve body biomechanics and manual handling techniques, (5) **psychological aspects** to improve the self-efficacy of cognitive behavioural therapy and; (6) **healthy lifestyle** to adopt and promote healthy lifestyle habits when suffering from LBP. Storyboard content and their presentation were designed to consider the challenges when developing a digital intervention through the flexibility of access, enhanced engagement and the use of features of behavioural change theory.

Once the initial storyboard content was developed, stakeholders, including healthcare professionals and members of academia, reviewed the WBI-BACK content and provided their feedback. The overall feedback was positive with regards to the content, multicomponent, layout images and reflective elements. The key suggestions that arose from stakeholders' comments were to summarise the content, improve psychological and healthy lifestyle content, provide graphic standardisation and engage in cultural context consideration. It was proposed that exercise and PA content must include clear images and detailed videos of good quality, since this is an important area where nurses are likely to participate in the management of LBP.

Once stakeholders' comments were addressed in the storyboard storyboard content, a prototype of the WBI-BACK content was developed. The final WBI-BACK intervention programme consisted of six modules: educational, exercise, PA, ergonomics, psychological aspects and a healthy lifestyle (see Table 7).

Table 7: WBI-BACK Intervention Programme Content

Section	Tab Header	Content
Module 1	Educational Gallery	- General definition of LBP and occupational LBP in nurses - Anatomy and physiology of the back - Predisposing factors of LBP in nurses - Management of LBP - Management and prevention of LBP in nurses
Module 2	Exercise Gallery	- General benefits of exercise - How exercise therapy can prevent and manage LBP - Types of exercises - Explanation and video demonstration of some strengthening exercises for the back, core, abdominal and leg muscles
Module 3	Physical Activity	- Explain the difference between physical activity and exercise - General benefits of being active - The types of physical activity (moderate and vigorous) - Examples of physical activity (walking, cycling and running) - Goal setting (physical activity diary sheet)
Module 4	Ergonomics	- General introduction about the mechanical risk factors for developing back injuries in nurses - Example of occupational intervention (body mechanics, proper manual handling techniques and back care) - How to maintain a good posture
Module 5	The Psychological Unit	- Psychological barriers to physical activity - Introduction to cognitive behavioural therapy - Self-efficacy - Examples of some relaxation techniques and mediation
Module 6	Healthy Lifestyle	- General introduction to promoting a healthy lifestyle - Stress management - Good sleep quality - Healthy eating

3.5.4 Stage 3: Iterative Peer Review

Objectives

The objective of this stage was to review the online version of the WBI-BACK intervention programme and pilot test the utility of the programme among relevant nurses.

Method

Adopting the Agile methodology in the development of the WBI-BACK intervention programme allowed reviewers to provide feedback at every step (Boyle et al., 2006). Therefore, peer review panels were asked to review the online version of the WBI-BACK programme and provide feedback. The panel consisted of 8 healthcare workers and members of education (5 female, 3 male) comprised of 6 physiotherapists and 2 nurses. These individuals were intentionally identified through the previous stakeholder consultations done in stage 2, as they were already familiar with the WBI-BACK content. They were sent a link to the WBI-BACK intervention programme by email and asked to produce feedback through an adapted version of the reusable intervention object peer review specification tool consisting of items adapted from the HELM Open-Reusable Learning Objects (RLO) evaluation toolkit for authorising learning objects (Appendix 2) as used in (Blake et al., 2020a; Blake et al., 2020b). The peer review form included 10 questionnaires considered for usability, access, format, presentation, navigation, clarity and interactivity.

Once peer reviews of the online version of the WBI-BACK intervention programme were completed, the WBI-BACK programme was pilot tested by the same expert panel. They were asked to use the same link to the WBI-BACK intervention programme that was sent by email to complete the entire digital programme according to their own schedule, record the completion time and raise any possible problems and barriers to use.

Results

The WBI-BACK intervention programme review process took place from July 2019 to August 2019. The responses from the peer review panel were received electronically by email. The overall feedback regarding usability, access, format, presentation, navigation, clarity and interactivity was positive. The reviewer's feedback allowed for further amendments to some sections in the education and exercise modules to meet the objective needs for interventions for LBP among nurses such as images and video downloading. Pilot testing for the WBI-BACK programme resulted in minimal amendments, including those for formatting, layout and technical issues. Once the peer reviews of the online version of the WBI-BACK intervention programme and piloting were completed, the WBI-BACK intervention programme was fully developed and ready for nurses' use. The resulting WBI-BACK intervention programme is available here <https://www.nottingham.ac.uk/toolkits/play20404> . Screenshots of the WBI-BACK intervention programme are provided in Figures 10, 11, 12 and 13. The WBI-BACK intervention programme is highly flexible for the end users and can be accessed at any time or place. Users can choose the modules they wish to engage with and how much content they access at any one time depending on their availability.



Figure 10: Example screenshot from WBI-BACK programme (Educational Gallery)



Figure 11: Example screenshot from WBI-BACK programme (Exercise Gallery)

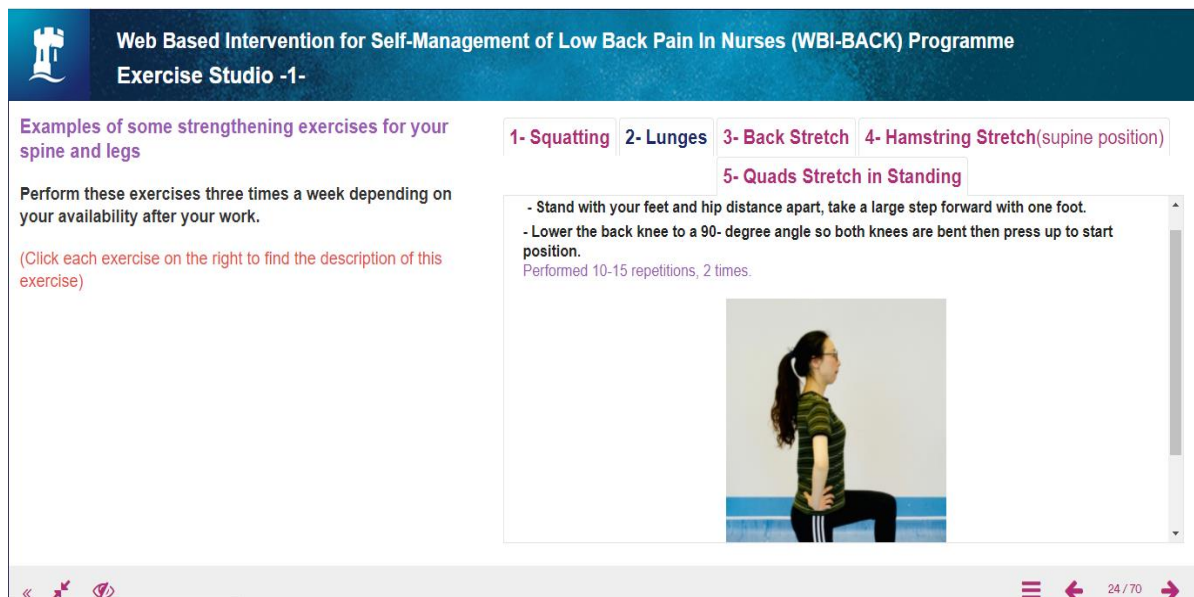


Figure 12: Example screenshot from WBI-BACK programme (Exercise Studio)

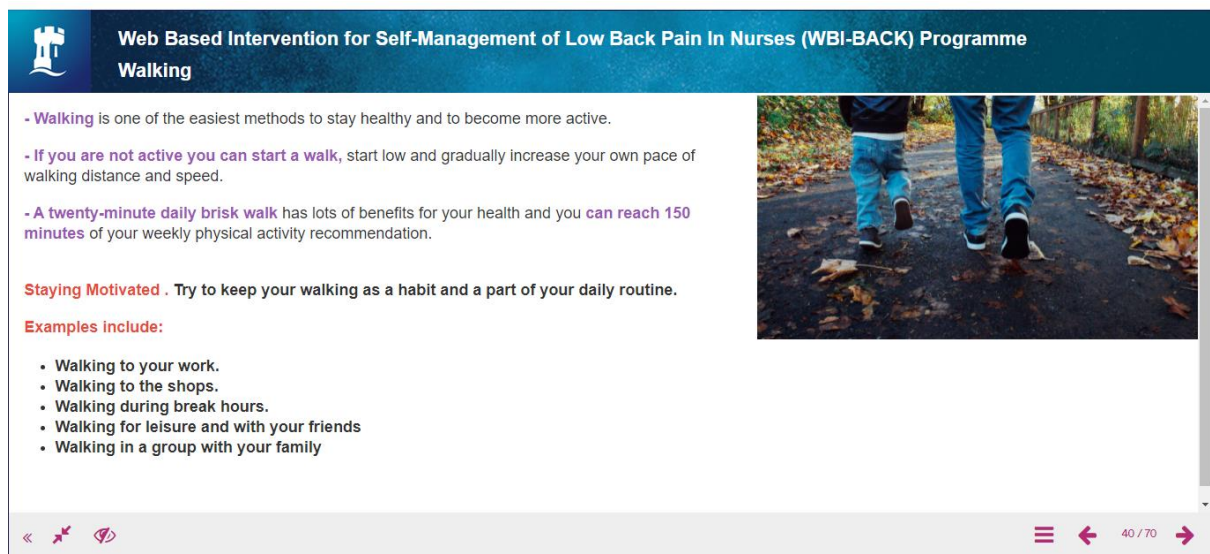


Figure 13: Example screenshot from WBI-BACK programme (PA)

3.6 Chapter Summary

The chapter focused on clarifying the process of designing and developing a theory- and web-based intervention for the self-management of LBP in nurses. The guidelines for developing a high-quality digital intervention were demonstrated by translating theories and evidence. An Agile approach was used to develop the WBI-BACK intervention programme, which included a co-creation process together with multidisciplinary stakeholder consultations and an iterative peer review panel. The development process was divided into three stages: stakeholder consultations, content development and prototyping and iterative peer review. The developed WBI-BACK intervention programme consisted of six modules: educational, exercise, physical activity, ergonomics, psychological aspect and healthy lifestyle. The next chapter will discuss the methodology used to assess the acceptability and feasibility of the WBI-BACK intervention programme for nurses working in Saudi hospitals.

Chapter 4: Research Methodology

4.1 Introduction

The previous chapter aimed to design, develop and evaluate a theory web-based intervention programme for self-management of LBP in nurses (WBI-BACK). This chapter provides an overview of the methodology that was used in the current research to assess the feasibility and acceptability of the WBI-BACK intervention programme for nurses with and without LBP. The principal aim for this chapter is to highlight and clarify how and why the research design and methods selected have been adopted to achieve the study's aim and objectives.

The researcher used a convergent parallel MMR approach, which combined quantitative and qualitative methods. The chapter starts by presenting the overall aim and objectives of the study, moving on to present the philosophical assumptions and research design. This is followed by a description of the research setting, recruitment process, data collection, and a discussion on data synthesis intervention and ethical consideration.

4.2 Study Aim and Objectives Revisited

The purpose of the study is to test the feasibility and acceptability of a WBI-BACK intervention programme developed for the prevention and treatment of LBP among the nursing population in the KSA.

Primary Objectives

To provide primary data about the feasibility and acceptability of delivering and assessing the WBI-BACK intervention programme for nurses with and without LBP in the KSA context. Specifically:

- To evaluate the feasibility and acceptability of the proposed full trial including participants' recruitment rate, attrition rate, appropriateness of selected outcome-

measures, intervention engagement and experiences of the intervention components based on TAM.

Secondary Objectives

To determine if exploratory analysis of certain LBP-related measures is sensitive to change after WBI-BACK intervention programme for nurses with and without LBP. Specifically:

- To measure the effects of PA level, fear-avoidance beliefs, pain intensity, physical functioning, health-related quality of life and self-efficacy before and after the WBI-BACK intervention programme.
- To identify the recommended level of PA before and after the WBI-BACK intervention programme.

4.3 Research Methodology Development

To achieve the study aim and objectives, MMR (Arain et al., 2010a), two group feasibility study was used. This part starts by outlining the research paradigm and philosophy that led to the research design.

4.3.1 Research Paradigm and Philosophy

As a philosophical researcher, it is essential to know the meaning of the word paradigm. A paradigm refers to “a set of beliefs about the world and about gaining knowledge that goes together to guide people’s action as to how they are going to go about their research” (Wilson, 2001). Collis and Hussey (2013) have defined the research paradigm as a framework that guides people on how to conduct their research based on their assumptions and philosophies about the world and the nature of knowledge. A research paradigm is not a methodology but rather a process of how to conduct research in a specific direction (Guba and Lincoln, 1994). It is not just a philosophical framework; it is also shaping how an individual should carry out

their research. Therefore, once the researcher has recognised the research paradigm to use, designing the research should be carried out by selecting a methodology that reflects the assumptions of the philosophy for the research paradigm (Collis and Hussey, 2013). Burrell and Morgan (2017) have illustrated the significance of the research paradigm and philosophy by highlighting how it helps researchers select and revise suitable research methodologies. It also helps them be creative and innovative in selecting a new approach that other researchers may not use. There are three main components of the scientific research paradigm: epistemology, ontology and methodology, seen in Table 8 (Smith, Thorpe, and Jackson, 2008).

Table 8: Three Components of the Scientific Research Paradigm

Category	Characteristics
Epistemology	General assumptions and parameters connected with an outstanding way to discover the real-world nature (Easterby-Smith et al., 2012)
Ontology	“How the researcher explains the reality from the researchers standpoint” (Lincoln and Guba, 1985b). Ontology explains an individual’s view on the nature of reality, which can be either objective (i.e. really exists) or subjective (i.e. only in your mind ; (Flowers, 2009).
Methodology	Combination of various technique used by the scientist to explore different situations (Easterby-Smith et al., 2012).

It is important to understand the philosophical assumptions used in social science research, as this represents a major paradigm which is used to select an appropriate method strategy (Easterby-Smith, Thorpe and Jackson, 2012). Creswell and Clark (2018) have shown that **positivism** and **interpretivism** are only two schools of thought (belief) in social science research. The **positivism** paradigm is based on the truthfulness of its results, which are presented in a valid and objective way (Scotland, 2012).

Positivism believes that there is only one reality shared with everybody in the world that is unknown to anybody (Chih-Pei and Chang, 2017; Creswell, 2013). Hence, in this philosophical assumption, a framework depends on the reality obtained from literature to describe the phenomenon. The concepts linked to positivism concepts are based on actual roots that are recognised as an accurate source for conducting and building an unalterable and sound base (Hart, 2017). The quantitative research paradigm is built on positivism and objectivism, and is known as ‘the scientific research’ (Creswell and Clark, 2011). Although positivism has the traditional belief of providing the truth of knowledge, post-positivism argues that positivists have challenged this traditional belief by examining human behaviours and actions. Positivism believes the claim that the researcher has only a single reality and needs to be gathering and collecting data objectively (Creswell and Clark, 2011). Therefore, the deductive approach has been used more for the positivist paradigm (Creswell and Poth, 2016).

In contrast, ***interpretivism*** believes in many realities that are socially built from the relationship context. This reality is known to experts, consultants and every society (Creswell and Plano Clark, 2011). Thus, in this philosophical assumption, frameworks are designed and developed by specialists and presented from various viewpoints. Interpretivism argues that reality is based on the understanding and explanations of humans’ unique perceptions and thinking of the world instead of developing a universal law (Crotty, 1998). The strength of interpretivist research allows for a greater depth in the analysis and contextual interpretation of humans’ social actions (Guba and Lincoln, 1994; Lincoln and Guba, 1985). The qualitative research paradigm is built on interpretivism and subjectivism (Creswell and Plano Clark, 2011). Interpretivism believes in the claim that many realities depend on the different contexts that exist. Therefore the researcher becomes an integral part of the research method through understanding and interpretation (Creswell and Plano Clark, 2011). The inductive approach has been used more within the interpretive paradigm (Creswell and Plano Clark, 2011).

Nonetheless, each of these paradigms provides a limited understanding of the world to discover and explore new knowledge (Creswell and Plano Clark, 2011).

Nonetheless, many researchers have supported the notion that both quantitative and qualitative approaches could be merged to investigate the process of social theory (Maarouf, 2019). More importantly, in developing a complex intervention, it is necessary to assess this intervention in a complex context that needs deep explanation (Creswell and Plano Clark, 2011). A MMR methodology combines quantitative and qualitative approaches into one study, which better understands the research problem and phenomena rather than relying on a single approach (Creswell and Plano Clark, 2011). The MMR methodology differs from both the philosophical assumptions advocated by positivism and interpretivism (Tashakkori and Teddlie, 2010). It creates information from both quantitative and qualitative findings. Through this approach, valid, reliable and generalisable findings (i.e. quantitative) are combined with in-depth, detailed and contextual knowledge (i.e. qualitative; (Greene and Caracelli, 2003).

It is important to explain how the conflict between quantitative and qualitative research paradigms can be overcome by adopting an MMR research approach (Johnson and Onwuegbuzie, 2004). **Pragmatism** is regarded as one of the most appropriate philosophical assumptions for MMR (Tashakkori and Teddlie, 2010). Many researchers have argued that pragmatism could offer a philosophical justification for MMR. Johnson, Onwuegbuzie and Turner (2007) have agreed that pragmatism is a philosophy that gives the epistemology of mixing quantitative and qualitative methods and approaches. Moreover, Creswell and Clark (2018) has argued that pragmatism allows the mixing of paradigms, approaches, assumptions and methods of data collection and analysis. Pragmatism is based on the concept that theories could be generalised and contextualised by analysing them for transferability to other situations (Shannon-Baker, 2016). It also concentrates on the research product (Biesta, 2010) and is interested in identifying the meaning of objects (Johnson and Onwuegbuzie, 2004). The

emphasis is on communication and shared meaning to create realistic answers to social problems (Shannon-Baker, 2016). Goldkuhl (2012) has recognised three forms of pragmatism to clarify the difference between action and knowledge from a pragmatic point of view: functional, referential and methodological pragmatism. Functional pragmatism implies that scientific knowledge aims to enhance the action and modify practice, while referential pragmatism explains the world in an action-oriented manner. Methodological pragmatism, on the other hand asserts that knowledge is built by actions to learn about the world.

Notwithstanding the above, pragmatism faces intense criticism for its essential assumptions. These involve questions such as ‘for whom is a pragmatic solution useful?’ and ‘what is meant by usefulness?’ (Mertens, 2003). Biddle and Schafft (2015) have also argued that pragmatic researchers using any research method think that the philosophy of their research is not connected to the practical value of this method. Others have argued that the quantitative and qualitative assumption paradigms are not adopted in pragmatism because they think that the quantitative and qualitative approaches are not reviewing the same phenomenon, which makes the mixing method for triangulation or cross-validation questionable. Therefore, a mixed researcher needs to clarify the paradigm or philosophical stance taken for the MMR approach.

4.3.2 Research Purposes

Research purposes can be one or more of explanatory, exploratory and descriptive (see Table 9; (Yin, 2011). They may have more than single purpose and might change over time (Goodenough and Waite, 2012). Therefore, exploratory, explanatory and descriptive research purposes were used in this study due to their flexibility (Figure 14).

Table 9: Type of Research Purpose (Robson, 2011)

Category	Characteristics
Explanatory	- Explanation and looking for a phenomenon or problem. - Describes patterns that relate to the research phenomenon. - Associations through the phenomenon factors. - Works with quantitative or qualitative designs.
Exploratory	- Used in small understood situations. - Explores new views. - Asks many questions. - Assesses phenomena from different opinions. - Makes hypotheses and produces ideas. - Mainly focused on qualitative methods.
Descriptive	- Describes the correct profile of conditions, persons, or events. - Requires extensive prior knowledge of conditions. - Flexibility of research design and can be both quantitative and qualitative.

4.3.3 Position of Researcher

In any piece of research, it is crucial for the researcher to conceptualise their ontology, epistemology and methodology. In this study, the researcher favours **pragmatism** (the belief that reality is non-singular and socially constructed) in terms of ontology and holds an **intersubjective** (relational) epistemological position. Figure 14 shows the researcher's position. Pragmatism allows researchers to use all methods and approaches to address the research questions and understand the problems (Greene and Caracelli, 2003). The assumptions of pragmatism are appropriate for this study, which uses different methodological approaches, assumptions and procedures for data gathering and analysis to answer the research questions. Due to the complex nature of assessing the feasibility and acceptability of a web-based intervention for nurses with and without LBP, there is no one paradigm that can be said to satisfy all the essential approaches for this study. Importantly, this is the first study to assess the acceptability of web-based interventions for nurses working in the KSA. Therefore, it is

essential to understand and evaluate all aspects of the research trial before implementing a full trial. Additionally, it is necessary to evaluate nurses' views and knowledge when developing and constructing a web-based intervention for LBP and explore their opinions and perceptions after engaging in a web-based intervention. Notably, the integration between quantitative and qualitative data was valuable in assessing whether they could add value to the LBP intervention for nurses in their working environment in Saudi hospitals. Hence, using two paradigms gives the researcher a greater chance to conduct a complete phenomenon study as well as having the advantage of a study design that includes both paradigms (Creswell and Clark, 2018). MMR provided the opportunity for researchers to cope with the 'false dichotomy' between two essential paradigms (Doyle, Brady and Byrne, 2009). Therefore, for this research, a combination of positivist and interpretive approaches were used in an MMR approach. There are many advantages in using a dual paradigm approach for this study. The benefits of research based on a positivist approach include using an outcome measures questionnaire method, which produces numerical data that be arranged and statistically analysed to develop an objective approach to reach a concept of reality (Tolley et al., 2016). This arrangement is important for testing the feasibility of detecting the change in outcome measures and can help to develop and create a successful intervention tool. This can help in enhancing the generalisation of the study results and their possible publication. Moreover, the positivist approach offers predictive capabilities for recognising the underlying difficulties (Tolley et al., 2016). This can give the researcher an idea about what variables may affect the difficulties in this investigation. The nurses may face difficulty during the implementation of the digital intervention, which needs to be considered when developing and designing a validated measurement tool for a full trial.

Conversely, the benefits of research from an interpretive paradigm include supporting the creativity of research by reflecting the researcher's engagement and ability to collect, analyse,

understand and reflect on the meaning of the data (Tolley et al., 2016). Furthermore, it gives meaning or sense to the research findings as interpreted by the primary researcher. Thus, this can help the creativity of this research when developing a new web-based intervention program. However, that intervention requires an understanding of the data regarding the nurses' perceptions and experiences of their engagement. Thus, the researcher believes it is essential to combine positivist/quantitative and interpretive/qualitative paradigms. Combining these paradigms allows the researcher to analyse the data statistically while testing the feasibility and acceptability of the web-based intervention with nurses who influence engagement.

Nevertheless, there are many criticisms of pragmatism, as discussed earlier, such as 'for whom is a pragmatic solution useful?' and 'what is meant by usefulness?' (Mertens, 2003) . Therefore, to answer the first question in this study, the preferred tools and practical interventions examine the feasibility of web-based interventions for nurses with and without LBP for PA level, fear avoidance belief, pain intensity, physical functioning, health-related quality of life and self-efficacy outcomes. There is a significant focus on the usefulness and the usability of the WBI-BACK intervention programme in assessing its feasibility and acceptability for the nursing population. Then, to explain what is meant by usefulness, two different methods were considered in this research approach:

- (1) This pragmatic approach will be suitable for developing an effective digital intervention using a combination of methods to collect the best knowledge to inform the development and delivery of the intervention.
- (2) This pragmatic approach will be useful for developing an intervention that will suit the nursing participants because it motivates and facilitates beneficial health changes such as pain, functional activity, quality of life and PA.

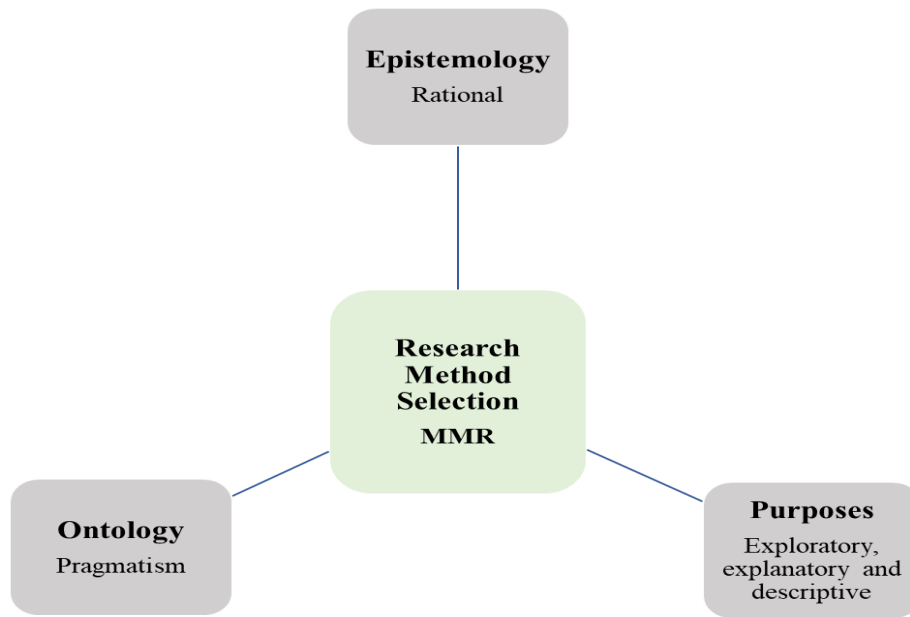


Figure 14: Research Method Selection

4.3.4 Research Design

The proposed study is based on an MMR methodology that uses both qualitative and quantitative elements. Both quantitative and qualitative approaches will provide knowledge of the need and impact of web-based intervention. MMR has become increasingly accepted as the third methodological approach over the last two decades and has been used in social science research since the early 1990s (Creswell and Clark, 2017). MMR is divided into three basic designs: convergent parallel MMR design, explanatory sequential MMR design and exploratory sequential MMR design (Creswell and Clark, 2018). There are two principal advantages of using MMR: complementary strength and triangulation (Sale, Lohfeld and Brazil, 2002). Complementary strength focuses on using the strength of one research approach to support and enhance another approach, as each approach has its strengths and weaknesses (Johnson and Christensen, 2019; Sale et al., 2002). The second advantage is triangulation, which enhances and strengthens research results by using different data collection and analysis

approaches to gain a complete understanding of the overall phenomenon (Molina-Azorin, 2016; Sale et al., 2002).

The methodology used in this research is a convergent parallel MMR, two-arm feasibility study. MMR was employed to evaluate the study objectives for the future trial. The integrations of results from both quantitative and qualitative approaches can lead to more comprehensive findings which in turn help to address the study's aim and objectives. This MMR approach comprises two component phases (Heyvaert et al., 2013):

- (1) Trial component: a quantitative two-arm feasibility trial.
- (2) Embedded qualitative component: qualitative semi-structured interviews, using thematic analysis.

The feasibility study protocol was designed according to the National Institute of Health Research-Evaluation, Trials and Studies Coordinating Centre (NIHR- NETSCC) for feasibility study design (Blatch-Jones et al., 2018) and the intervention was reported in accordance with the Template for Intervention Description and Replication (TIDieR) checklist for describing of interventions (Hoffmann et al., 2014).

Quantitative and qualitative data were collected separately, but then discussed in an integrated manner. The quantitative data design involved a descriptive, cross-sectional design using structured outcome-measure questionnaires, and the qualitative data collection employed interviews. Figure 15 demonstrates the study design, summarising the sequence of research activity methods and the stage in which triangulation and integration occurred (Ivankova, Creswell and Stick, 2006) . Both data collection designs will be explored later in this chapter.

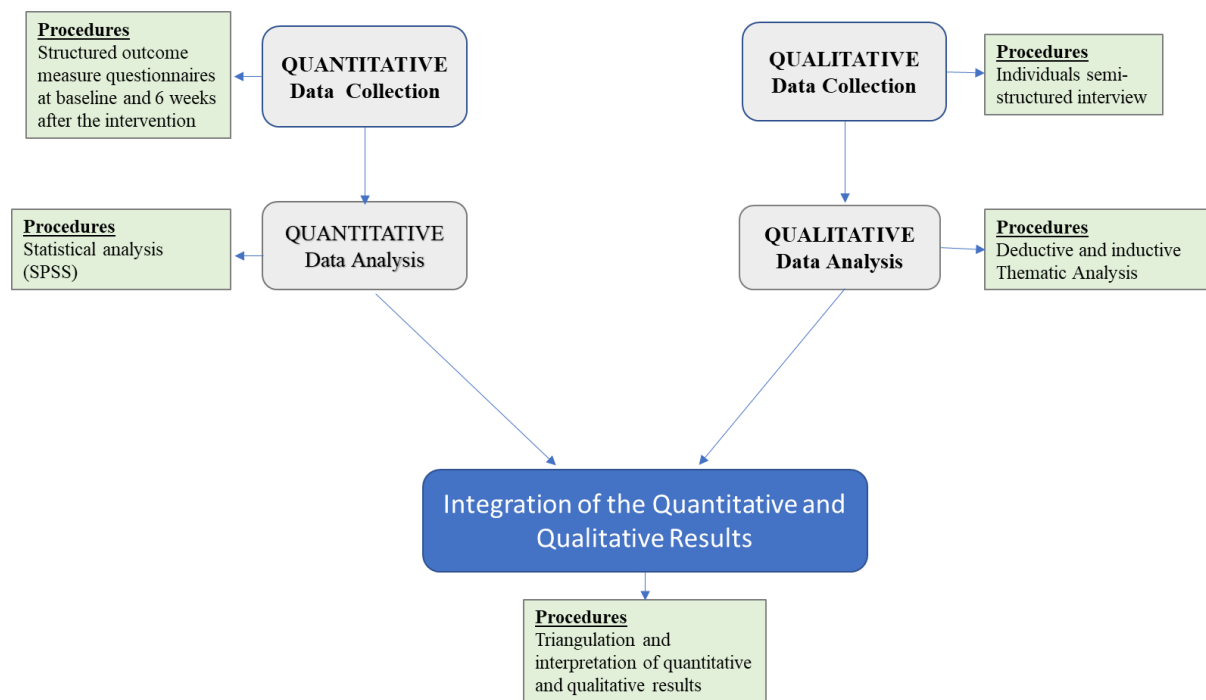


Figure 15: Diagrammatic Representation of MMR Convergent Study Design

4.3.5 Rationale for the Feasibility Study not Feasibility RCTs

The feasibility studies depend on the generation of results that help decide the efficacy testing of an intervention (Bowen et al., 2009). Owing to the contemporary nature of digital health intervention in the KSA, no studies have examined the usability and acceptability as well as the effectiveness of digital intervention for musculoskeletal conditions such as LBP, especially among the nursing population. The rationale for the feasibility study is necessary due to the following factors: 1) the intervention (WBI-BACK intervention programme) will need significant cultural adaption in the KSA, even though it has been assessed for effectiveness previously in Western cultures, 2) the WBI-BACK intervention programme remains unexplored for effectiveness in nursing populations, 3) because a high-quality clinical trial involving nurses with LBP remains unexplored in the KSA, it is unclear whether a feasibility RCTs study is feasible. Therefore, the results from planned feasibility study design required

careful consideration to inform the design and plan of a future feasibility RCTs to investigate the acceptability, usability and the effectiveness of the WBI-BACK intervention programme in a nursing population.

4.4 Procedures

4.4.1 Sample Size

National Institute of Health Research (NIHR) guidelines for feasibility trials were followed in this study, therefore, no formal sample size calculation was considered, with 40-50 participants targeted for the sample size. According to the previous feasibility studies, it is estimated that a sample size between 40 to 50 participants was adequate for testing the feasibility objectives (Sharma et al., 2019; Orsmond and Cohn, 2015; Arain et al., 2010; Tickle-Degnen, 2013) and could achieve the nature of PhD study. Nurses with and without LBP who were interested in participating in this study were selected based on a number of eligibility criteria, which are outlined in the next few sections of the study as well as the inclusion and exclusion strategy adopted. Importantly, nurses without LBP were involved in this feasibility study to understand the potential for the WBI-BACK programme as a preventive tool for LBP.

4.4.1.1 Inclusion Criteria

Nurses were included if they were male or female, aged >18 years and:

- Working full time in the KFMC Rehabilitation Hospital.
- Could access the internet in the hospital or at home.
- Were able to speak, read, write and communicate in English (to understand the study objectives and give written informed consent as well as being able to independently access the WBI-BACK programme).

4.4.1.2 Exclusion Criteria

Nurses were excluded if they:

- Were pregnant.
- Not fluent in the English language or needed help with interpretation for reading or/and writing.
- Unable to receive emails or/and complete online questionnaires.
- Were identified as being at risk for exercises and physical activity linked to the revised Physical Activity Readiness questionnaire (PAR-Q; (Adams, 1999)).

4.4.2 Research Setting

Participants were recruited from the KFMC Rehabilitation Hospital, based the capital city of Riyadh, KSA (Figure 16). The researcher contacted KFMC to get formal approval to conduct this study, with initial agreement being obtained from the Institutional Review Board (IRB) Chairman. KFMC was selected as it is the largest and most rapidly-growing healthcare organisation in the Gulf Region and Middle Eastern countries. It comprises four hospitals (Obstetrics and Gynaecology, Rehabilitation and the Children's Specialist Hospital and General Hospital), four medical centres (National Neuroscience Institute, King Salman Heart Centre, Comprehensive Cancer Centre and the Obesity, Endocrine and Metabolism Centre) and many supporting administrative units. KFMC has the advantage of being able to use the latest technology for treating patients and for medical service administration. Importantly, KFMC has qualified employees in its working environment, which enhances its ability to disseminate medial-related knowledge and foster a strong culture of development in the community (KFMC, 2022).

The researcher for this study was a KFMC staff member in the rehabilitation hospital and still has a working relationship with the administrative staff, who helped facilitate the recruitment

of participants from the hospital. The study was also conducted to facilitate recruitment. KFMC is the only hospital in the KSA that provides acute rehabilitation services to all patients referred through an interdisciplinary rehabilitation programme (KFMC, 2022).



Figure 16: KFMC Hospital - study setting (KFMC, 2022)

4.4.3 Recruitment Process

Recruitment for participants was conducted on 1st October 2019 and ran until 30 January 2020. Participants were recruited in the study using a convenience sampling strategy. This sampling technique is the most popular approach for recruiting research participants in feasibility and pilot studies and randomized control studies (Martínez-Mesa et al., 2016; O’Cathain et al., 2015; Hicks, 2009). Participants who fitted the eligibility criteria were recruited consecutively to decrease selection bias (Hicks, 2009).

Recruitment for the study was conducted via a multilevel process. The first stage involved meeting with Executive Director of Nursing at KFMC to provide information on the trial itself and to discuss distribution of the nurse’s invitation letter and recruitment materials. Secondly,

a meeting was arranged with the Chairman of Research at KFMC to discuss the study procedures and recruitment. Then a meeting was held with all head nurses at KFMC to discuss the research and recruitment processes. Finally, an advertisement for the study (See Appendix 3) was sent to all head nurses in the rehabilitation sections of KFMC by the Chief Nursing Officer. In addition to this, the PR had gained approval and permission to visit all hospital departments to distribute invitation letters and posters to the head nurses.

The head nurses displayed the research poster on the nurse's notice board, and they agreed that recruitment would be done separately by each department at KFMC. During the process of promoting the study and recruitment, the PR was present during early mornings in the hospital (around 7:00 am) to ensure that all night and morning shift nurses understood the research rationale, study duration and perceived benefits. The PR answered queries about the research and provided contact details for the research team if anybody wanted to discuss the research in more details. The PR facilitated the entire recruitment process for any questions about the study and responded to any concerns or queries that arose. Participants who expressed an interest in participating in this study were asked to contact the PR and screened for eligibility (according to the inclusion criteria strategy). Participants who met the eligibility criteria were provided with the participant information sheet (see Appendix 4). In order to comply with ethical concerns, participants were given sufficient time (48 hours) to read the participant information sheet and consider whether they wished to participate or not. The participants were informed that their participation in the study was voluntary and that they could withdraw at any time, although attempts would be made to avoid this from occurring.

Where participants agreed to participate in the study, the PR arranged a suitable date and time in the private meeting rooms in the hospital wards depending on their availability. On the allocated date and time, signed consent forms (see Appendix 5) were collected. The total

number of participants who were recruited and participated is stated in the next chapter (Chapter 5, section 5.2).

4.4.4 Data Collection

Following the recruitment process and consent procedures, data was collected via self-administered questionnaires. Participants who met the eligibility criteria were recruited consecutively to decrease selection bias (Hicks, 2009). The PR collected anthropometric and demographic data (e.g. age, gender, nationality, current position, number of years' experience and name of department in KFMC). Participants were also asked if they had experienced LBP in the last four weeks. LBP was defined as pain centred between the coastal area and the lower gluteal folds that may be accompanied by numbness or leg pain (Dionne et al., 2008). Participants were separated into two groups; LBP group and NOLBP group, based on the self-reported presence or absence of LBP.

Participants were invited to complete self-reported online outcome measure questionnaires (PA, fear-avoidance beliefs, pain intensity, physical functioning, health-related quality of life and self-efficacy, Appendix 6), embedded in an electronic platform, hosted at the Jisc online survey website, <https://www.onlinesurveys.ac.uk/> . The Jisc online survey was developed by the PR using the University of Nottingham (UoN) username to allow real-time data collection and storage. A link to the Jisc online survey was emailed to participants in the LBP group (<https://nottingham.onlinesurveys.ac.uk/lbp-nurse-new-survey>) and the NOLBP group (<https://nottingham.onlinesurveys.ac.uk/last-no-lbp-new-survey>) for completion. The baseline outcome measure questionnaires were completed face-to-face on the PR's laptop on the same day the participant was recruited. Participants were able to ask questions about the questionnaires in case they had any queries for the PR.

Lists of recruited participants in both the LBP and NOLBP groups were registered by the PR at the end of each week of the recruitment period and categorised. One week before the end of the 6 weeks, a PR contacted the participant via email to arrange a time to conduct the 6-week follow-up outcome measure questionnaires, which were also completed online on a PR's laptop. If the participant was unable to meet the PR, the questionnaires were sent via email by the end of the study period. The participants were contacted three times through their emails to collect the online follow-up data, however, if they did not respond, they were withdrawn from the study. The follow-up outcome measure questionnaires consisted of the same initial measures (PA, fear-avoidance beliefs, pain intensity, physical functioning, health-related quality of life and self-efficacy), a questionnaire based on TAM (Davis,1989; Appendix 7) and self-reported usage data (Appendix 8).

Finally, participants were invited to join the semi-structured interviews to explore their experiences and responses to the WBI-BACK intervention programme (See chapter 6 for more details). In addition, the same participants were invited to take part in a semi-structured interview. The invitation for this phase was explained in the study information sheet. For those participants who were willing to participate, another consent form (see Appendix 9) was signed to agree to and authorise audio recording, the content of which would be bound rules governing data confidentiality. Informed consent forms were collected from each participant before they were allowed to join the study, with one copy kept by the researcher and another copy kept by the participants.

4.4.5 Intervention

An Agile approach was used to design, develop and evaluate a theory web-based intervention programme for a selected nursing population in the KSA (see chapter 3, section 3.5). The digital intervention programme was developed for purpose of the study to assess its

acceptability and feasibility for nurses working in Saudi hospitals. The overarching aim of the WBI-BACK intervention programme was to promote self-management behaviour of LBP for nurses with and without LBP using a specific self-management strategy. The WBI-BACK programme consisted of 6 modules: educational, exercise, physical activity, ergonomics, psychological aspect and health lifestyle. Once the participant completed the initial online study questionnaires, the link to the WBI-BACK intervention programme was sent by PR via their emails. The participants could access the WBI-BACK intervention programme for six weeks using a computer or mobile phone at the hospital or at home during the study intervention period. It was suggested that 6 week web-based intervention was realistic with patients and reflected recent practices which was supported by a recent systematic review (Du et al., 2011). The participants were able to choose between different modules of information in the WBI-BACK intervention programme at any time. They were encouraged to access the programme at least once a week, depending on availability and their ability and willingness to participate. Participants were also able to contact the PR by email if they had any questions about the intervention during the study period (six weeks). Finally, the participants were asked to keep a PA diary sheet (see Appendix 10) during the six-week study period to be collected by the PR at the end of the study intervention.

The PR offered a one-hour training workshop to all participants to familiarise them with the web-based intervention. Specifically, participants were provided with information about how the WBI-BACK programme would work, the rationale underlying this intervention, the importance of regular physical activity and adopting a healthy lifestyle to manage LBP. Participants were encouraged to set their goals each week. They also had the opportunity to increase their level of PA or change to different activities until they meet their target level of PA based on World Health Organization (WHO) recommendations. The details of the PA

recommendations were presented in the WBI-BACK programme. The training workshop ran for two sessions and was held in a lecture room at KFMC following the implementation of the intervention. It was recommended that participants attend one training workshop, depending on their availability, although this was not mandatory for participants. The training material was sent to all participants via their emails even if they did not attend the event. A weekly reminder email was sent to all participants embedded in an electronic link to the WBI-BACK programme by the PR to motivate or encourage their engagement. The intervention details are demonstrated in Table 10 in accordance with TIDieR checklist (Hoffmann et al., 2014).

Table 10: Intervention Description using the TIDieR Checklist

Item Number	Item
Brief name	A web-based intervention programme for the self-management of LBP (WBI-BACK) intervention programme.
1. Why?	LBP is a major occupational problem among nurses which is associated with decreased job productivity, greater absence time, disability and functional limitation. A digital technology intervention is an innovative way of approaching behavioural self-management for patients with LBP. The successful implementation of digital interventions has been conducted in Western contexts. Nevertheless, no studies have been undertaken in the KSA, specifically within the nursing population. Therefore, this intervention was developed for the prevention and treatment of LBP for nurses working in the KSA.
2. What material?	-A specifically designed web-based intervention (WBI-BACK) programme to support nurses with and without LBP to become skilful in self-managing their LBP to decrease pain and related disability through the use and self-monitoring of behavioural strategies to improve self-care and LBP prevention behaviour. -A one-hour training workshop to familiarise participants with the WBI-BACK programme which encouraged them to set their goals (on a weekly basis) and increased their physical activity. -Weekly reminder emails (for six weeks) embedded the electronic link to the WBI-BACK programme to motivate the engagement.
3. Who provided it?	The PR (R.A) with a professional background in physiotherapy of more than 15 years, supervised by (P.H) who was a professional in physiotherapy for more than 20 years and (H.B) who was experienced in designing and evaluating digital health interventions in the workplace area.
4. How?	The WBI-BACK intervention was delivered to participants through their email, using a computer or mobile phone at the hospital or at home at any time.
5. Where?	The WBI-BACK programme was delivered to the nurses with and without LBP working at KFMC's Rehabilitation Unit in Riyadh, KSA.
6. When and how much?	-The initial interview and face-to-face assessment occurred at the beginning of the intervention period and lasted for approximately 30 minutes. -Participants were able to access the WBI-BACK programme for six weeks at any time. They were encouraged to access it at least once a week, depending on availability. -Semi-structured interview lasted 20–30 minutes and was audio-recorded.
7. Tailoring	The PA plan was tailored to participants to set their weekly goals depend on their PA level and preference.

4.5 Nature of the Quantitative Research Phase

This section presents an overview of the method and analysis used in the quantitative phase. The strength of the quantitative approach lies in its ability to measure and compare outcomes before and after the WBI-BACK intervention programme.

4.5.1 Aim of the Quantitative Research

The quantitative study aimed to produce knowledge and identify the likelihood of changes in LBP-related measures including PA level, fear-avoidance beliefs, pain intensity, physical functioning, health-related quality of life and self-efficacy after the WBI-BACK intervention program and to identify the recommended level of PA before and after the WBI-BACK intervention programme. The purpose of quantitative data was also to investigate the feasibility main outcome measures. Two groups (pre- and post-individual intervention) were used to achieve the quantitative study objectives.

4.5.2 Data Collection Method

Quantitative data used in this study was collected through primary and secondary outcomes. The details of these outcomes are described in the following section.

4.5.2.1 *Primary Feasibility Outcomes*

The primary outcomes of the definitive planned study are descriptive and used to evaluate the feasibility study objectives. A process evaluation (Hawkins et al., 2019) was conducted to assess the acceptability and feasibility of the WBI-BACK intervention programme and evaluation method involving recruitment rate, follow-up rate and attrition rate, feasibility of outcome measures, intervention engagement and experiences of the intervention. Questions related the WBI-BACK intervention experience were based on the key concepts in TAM (e.g.: ease of use, perceived usefulness attitude to the use) (see Appendix 7). The primary feasibility

outcomes were collected and assessed through predetermined progression criteria (Hawkins et al., 2019, Hallingberg et al., 2018). See chapter 7.

4.5.2.2 Secondary Outcome Measures

The secondary outcome measures were collected by questionnaires to compare PA, fear-avoidance beliefs, pain intensity, physical functioning, health-related quality of life and self-efficacy for participants in the LBP group. For those in the NOLBP group, only physical activity, general health and self-efficacy were assessed. The selected outcome measures questionnaire for this study was collected using reliable and valid tools explained in previous literature and believed to be most suitable to evaluate the study's objectives while decreasing the burden on participants (Chiarotto et al., 2015). The questionnaires were collected at baseline and 6 weeks after the WBI-BACK intervention (pre-post questionnaires). In this definitive study, all outcome measures used the English language which is the main language for healthcare workers in the KSA. The main details of these measures are described below and in appendix 6.

4.5.2.2.1 Physical Activity (PA)

PA was assessed in this study by the International Physical Activity Questionnaire (IPAQ) instruments, which is the most widely used option for research purposes and is recommended as a cost-effective method to evaluate physical activity (Lee et al., 2011). It was developed as an international measure for physical activity in Geneva in 1998 (Craig et al., 2017). The IPAQ can be used in developed countries and in developing countries for observing PA levels among the population, from those who are 18–65 years old (Craig et al., 2003). This instrument has been used widely in many studies within different contexts. The IPAQ has two versions: the 31-item long version and the 9-item short version (Craig et al., 2017). In this study, the IPAQ short version was selected to assess the participants' PA.

The IPAQ evaluates four intensity levels: vigorous-intensity physical activity, moderate-intensity physical activity, walking and sitting, which people do as part of their daily living (Craig et al., 2017). Participants were asked about the number of times they did vigorous and moderate PA and the time spent walking and sedentary sitting over the previous seven days. The IPAQ was used in this study because the main objective of the web-based intervention programme for the self-management of LBP was to increase PA level, which was expected to encourage nurses' to engage in exercise and physical activity after the WBI-BACK intervention. The test-retest reliability data for IPAQ short form was at an unacceptable level, with 75% of the correlation coefficients displaying from 0.65–0.88 (Craig et al., 2003). The concurrent validity coefficients between IPAQ forms showed reasonable agreement for short and long versions (Craig et al., 2003). The pooled p for comparison between different short forms was 0.58 (Craig et al., 2003).

4.5.2.2 *Fear of Movement*

Fear of movement was studied using the Fear Avoidance Beliefs Questionnaire (FABQ). The FABQ was developed by Waddell et al. (1993) and contains 16 self-reported points with two subscales: FABQ related to physical activity and FABQ related to work (Craig et al., 2003; Waddell et al., 1993). Participants scored their responses using a seven-point Likert scale measure, ranging from 0 (completely disagree) to 6 (completely agree). Hence, the total scores varied from 0 to 24, with higher scores representing a higher level of FABQ (Werneke et al., 2009). The FABQ demonstrated acceptable psychometric properties such as reliability, validity and responsiveness (Monticone et al., 2020). Specifically, Cronbach's alpha was 0.75 for FABQ PA and 0.85 for FABQ work scales (Monticone et al., 2020). Minimum detectable change (MDC) scores were 3.69 points for FABQ PA and 5.95 for FABQ work scales (Monticone et al., 2020). For this study, FABQ was chosen because patients with chronic LBP frequently display dysfunctional beliefs and increased fear avoidance traits, leading to an

avoidance of spinal movement and decreased daily activity. When sustained over time, this movement avoidance could contribute to chronic and sustained pain (Leeuw et al., 2007).

4.5.2.2.3 Pain Intensity

Pain intensity was assessed using the Numerical Rating Scale (NRS). The NRS is a self-reported measurement tool containing a one-dimensional 11-point scale (0–10) for measuring pain intensity, where 0 signifies no pain and 10 denotes maximum pain (Hawker et al., 2011). Participants within the LBP group were asked to score their back pain intensity over the previous two weeks and their average pain level for that day using this 11-point rating scale (Farrar et al., 2001). The NRS has been shown to be preferable to the Visual Analogous Scale (VAS) for patients with pain due to its clarity and simplicity (Farrar et al., 2001; Hawker et al., 2011). The NRS has been commonly used in pain trials and shows good reliability, validity and responsiveness (Ferraz et al., 1990; Childs, Piva and Fritz, 2005). The test–retest reliability for the NPRS is moderate to high, ranging from 0.67 to 0.96 (Kahl and Cleland, 2005). A decrease of 2.5 in NRS scores has been shown to be a clinically significant difference for patients with chronic LBP (Ostelo and de Vet, 2005).

4.5.2.2.4 Physical Functioning

The Roland Morris Disability Questionnaire (RMDQ) is one of the most extensively used outcome measures for LBP (Roland and Fairbank, 2000). It has been selected for this study to measure back-specific activity ranging from self-care to more difficult activities which represent different physical functional activities that were likely to be affected by patients with LBP (Roland and Morris, 1983). This instrument has been used within different contexts and adapted across different cultures (Chiarotto et al., 2016a). It consists of a 24-item questionnaire assessing physical activity, psychological factors, activity linked to daily living, sleep, pain and appetite. It takes approximately five minutes for the participants to complete (Roland and Morris, 1983). Scores vary from 0 (no disability) to 24 (highest disability), with a 3.5 change

in points which is considered to be clinically significant (Ostelo and de Vet, 2005). The RMDQ has been used in clinical practice and research demonstrating adequate reliability, validity and responsiveness (Mokkink et al., 2010). It is a reliable tool with test–retest reliability ranging from 0.88 to 0.91 (Roland and Morris, 1983). The internal consistency of the RMDQ is reported to be between 0.77 and 0.93 (Müller et al., 2004).

4.5.2.2.5 *Quality of Life*

A 12-item short-form health survey (SF-12) was constructed for individuals to assess their health-related quality of life (Ware Jr et al., 1996; Ware Jr and Sherbourne, 1992). SF-12 was constructed from the Medical Outcome Study short-form 36-item survey (SF-36) in an effort to decrease participants' burden and save data collection costs (Ware Jr et al., 1996). SF-12 consists of 12 items with choice response selections. It is divided into two subscales: physical and mental component summaries. SF-12 demonstrated good internal consistency and reliability in LBP patients, with Cronbach's Alpha for both subscales greater than the recommended level of 0.70 (Luo et al., 2003). It also demonstrated good construct validity and responsiveness in patients with LBP (Luo et al., 2003). Therefore, the SF-12 might be considered a suitable health-outcome instrument for future LBP clinical studies. Improving health-related quality of life is the primary goal of intervention for patients with LBP (Luo et al., 2003).

4.5.2.2.6 *Self-Efficacy*

Self-efficacy has been highlighted as a technique that can increase the success rate of an intervention, particularly in terms of changing lifestyle and sustaining adherence to exercise which can be effective in self-management for patients with chronic LBP (Keogh et al., 2015; Oman and King, 1998). Self-efficacy is known as an individual's confidence in their own ability to successfully complete specific tasks or behaviour to generate a desirable outcome (De Moraes Vieira et al., 2014). Self-efficacy is the main construct of SCT and represents an

important predictor for many behaviours (Alexanders, Anderson and Henderson, 2015; see chapter 3 section 3.3.1). There are many instruments that have been used in the past to measure self-efficacy, however, the Self-Efficacy for Exercise scale (SEE) is the most widely used for research purposes and different contexts. The SEE demonstrates good reliability for internal consistency based on Alpha coefficients of 0.92 (Resnick and Jenkins, 2000). In addition, there is adequate evidence to support the validity of SEE using criterion and construct-related validity showing better mental and physical health with individuals who have stronger self-efficacy expectations (Resnick and Jenkins, 2000). In this study, SEE was used to assess self-efficacy of exercises for nurses with and without LBP before and after the WBI-BACK intervention. Participants scored their confidence on a scale between 0 (not confident) and 10 (very confident) about the exercise components that were suggested on the WBI-BACK programme if they faced obstacles such as pain or depression (Resnick and Jenkins, 2000). The total score was calculated by providing an overall total to the responses for each question. This scale has a range of total scores from 0–90. A higher score indicates higher self-efficacy for exercise (Resnick and Jenkins, 2000).

4.5.3 Quantitative Data Analysis Strategy

The principal analysis for this study focused on a report of the key feasibility outcomes including recruitment rate, attrition rate, feasibility of outcome measures, intervention engagement and experience of the intervention components based on the TAM model; this is explained in detail in Chapter 7. The use of web-based intervention was explained by reporting the number of participants who engaged in the WBI-BACK intervention programme each week (see Appendix 8). The proportion of participant engagement in the web-based intervention was computed (n (%)) in both LBP and NOLBP groups). Questions related to the experience of the intervention components were created based on key concepts in TAM (Davis, 1989) such as

ease of use, usability and attitude toward the digital intervention (see Appendix 9). Response options were on 5-point scales (strongly agree, mostly agree, I do not know, mostly disagree and strongly disagree) and a percentage (n (%)) in both LBP and NOLBP groups) calculated based on the scores for the options of mostly agree and strongly agree.

Quantitative data were analysed also using the Statistical Package for the Social Sciences version 25.0 (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp).

(<https://www.ibm.com/support/pages/how-cite-ibm-spss-statistics-or-earlier-versions-spss>). A paired-sample t-test was used in the LBP and NOLBP groups' pre- and post- intervention, based on the understanding that the present study was not designed to determine statistically significant differences. Descriptive statistics (means, standard deviation (SD) and frequency distribution) were used to report the baseline demographic characteristics and clinical data of all the participants in the LBP and NOLBP groups. A normality test was used to assess the data for requiring a parametric or non-parametric statistical analysis test. All data were tested for the highest values, and boxplots were checked for outliers. Non-parametric tests were used if data were considered to go beyond the ranges associated with normality. Paired-sample t-tests were conducted to compare the different scores of self-reported PAs, fear of movement, pain intensity, physical functioning, quality of life and self-efficacy before and after the intervention for both LBP and NOLBP groups. The level of significance in relation to the efficacy of the web-based intervention will not be performed due to the insufficient power of the current study. As for PA, the proportion of participants meeting moderate and vigorous PA recommendations based on the American Heart Association (Health and Services, 2008; Bull et al., 2020) after the WBI-BACK intervention programme were calculated in both groups and compared to the baseline.

4.6 Nature of the Qualitative Research Phase

The qualitative research approach allowed the researcher to investigate the participants' opinions on the intervention, examining any related aspects and determining the processes that could potentially mediate any detected intervention effects (Wight and Obasi, 2003). According to Malterud, Hollnagel and Witt, (2001), qualitative research highlights the systematic collection of information from textual materials and analyses information acquired from data collection that explains insights into social phenomena in a neutral context such as experiences and perceptions from the population. The findings from the qualitative data were valuable for gaining a deeper understanding of nurses' perceptions regarding the WBI-BACK programme before seeking to implement it into a larger nursing population. In order to investigate and explore experiences and perceptions of healthcare interventions, qualitative methods, including semi-structured interviews, are suggested to gain more recognition of the dynamics of participation (DeJonckheere and Vaughn, 2019).

4.6.1 Aim of the Qualitative Research

The qualitative phase aimed to explore the experiences of nurses with and without LBP using the WBI-BACK programme and their acceptability of the intervention as well as suggestions for improvement. This aim was achieved by identifying more definite objectives. First, this involved exploring the nurses' behavioural interactions with the WBI-BACK programme by investigating acceptability, engagement and usability of the programme in the management and prevention of LBP. Second, this involved acquiring more understanding from the nurses based on their thoughts and feedback and encouraging them to discuss their opinions about the usability, engagement and attitudes toward the digital programme. In particular, the qualitative phase was intended to evaluate the WBI-BACK programme and deliver a means by which the importance of this area might be investigated in a larger population within different contexts.

4.6.2 Sampling and Participant Selection

After the quantitative data collection, the same participants were invited to join the semi-structured interviews to explore their experiences and attitudes toward the WBI-BACK intervention programme. For qualitative research, there are many approaches to selecting participants. A purposive sampling approach produces an additional, comprehensive understanding of the study phenomena and provides a rich data source (Creswell and Clark, 2018). Hence, a purposive sampling approach was used in this study to ensure that nurses with and without LBP (who met the eligibility criteria) had experiences with the phenomena of interest. Participants were purposively selected to ensure a wide range of males and females within different age groups and PA levels. This strategy has been used to understand the comprehension of the physical activity questionnaire (Durante and Ainsworth, 1996). Nurses in both groups were included to gather data from different perspectives that matched the inclusion criteria (Adami and Kiger, 2005). It has been suggested that an 8–20 participant sample size may be considered enough to comprehensively understand the research phenomena (Whitehead and Whitehead, 2016). Thus, a purposive sample of 16 participants (representative of all genders, ages and presence of LBP) was utilised, as this sample size has been suggested in the literature (Whitehead and Whitehead, 2016).

4.6.3 Qualitative Data Collection Strategy

A qualitative process evaluation consisting of follow-up interviews with predetermined topics and open-end questions forming the basis of an interview schedule was employed (Ryan, Coughlan and Cronin, 2009). This type of interview has the degree of flexibility required to follow issues raised by participants that had not been anticipated (Ryan et al., 2009). Semi-structured interviews are the most common data collection method used for the qualitative approach and in the health care research context (Gill et al., 2008; DiCicco-Bloom and

Crabtree, 2006) because they are flexible and versatile (Kallio et al., 2016). The use of semi-structured interviews is suitable for data collection since the study focuses on exploring individual perspectives, as well as the experience of using the WBI-BACK programme (Offredy and Vickers, 2013). One of the main benefits of semi-structured interviews is that it allows reciprocity between the participants and the interviewer (Galletta, 2013). The use of semi-structured interviews allows an individual to schedule the interview, according to the area that the study intends to cover. Moreover, it provides the researcher with greater control on the area of focus, ensuring that the study is aligned with the objective of the qualitative research. A semi-structured interview presents a chance to consider new information, which may not have been identified at the beginning of the study (Kallio et al., 2016).

In this sense, semi-structured interview guided the development of open-ended questionnaires and were conducted in this study. Thus, to investigate why the intervention may or may not work in this context and explore satisfaction with the WBI-BACK intervention; barriers and facilitators of the digital intervention; the perceived impact of the intervention and utility of the tool including suggestions for potential changes and improvements (See Appendix 11). It was predicted that this method would allow the researcher to gain a deeper understanding of the complex phenomena of participants' interaction with the WBI-BACK programme and explore the usefulness, engagement and usability of incorporating this intervention digital programme into the management and prevention of LBP. The topic guides for the participants (nurses with and without history of LBP) were developed by the PR and the main supervisors (see Table 11). These both confirmed that the interview questionnaires were relevant to the study's aim and objectives. All interviews were conducted in person by a PR to increase the participants' familiarity with the data. Semi-structured interviews were undertaken with nurses in the research settings (i.e., the KFMC Rehabilitation Hospital).

Table 11: Topic Guides for Nurses' Interview

Topic guides for nurses' interview
• Whether nurses accessed the WBI-BACK programme for the required period 6 weeks (usability). • Whether nurses enjoyed the WBI-BACK intervention (usability). • Whether nurses thought the WBI-BACK programme was easy to use (usability). • Whether nurses found the WBI-BACK programme was easy to navigate (usability). • Whether nurses found the images, videos and interactive elements in the WBI-BACK programme beneficial, useful, and easy to use (usability). • Whether the nurses thought that WBI-BACK programme has made any differences to their back pain (usefulness). • Whether nurses thought the WBI-BACK programme increased their knowledge to take care of their back (usefulness). • Whether nurses thought the WBI-BACK programme increased physical activity level (usefulness). • The barriers to participation to the WBI-BACK programme, including reasons for non-adherence, attrition, and missing data (engagement). • The suggestions and recommendations for improvement of the WBI-BACK programme. (Engagement)

4.6.4 Qualitative Data Analysis Strategy

A thematic analysis approach was utilised to identify key data themes (Braun and Clarke, 2006). Qualitative data were coded and analysed by the PR with guidance from expert researchers in qualitative research from the University of Nottingham (supervisors: PH and HB). Thematic analysis followed the guidelines proposed by (Braun and Clarke, 2006) to analyse and report the data (see Table12). All interviews in this study were conducted in the English language, and audio recordings needed to be transcribed verbatim to analyse the data. The PR transcribed all interview transcripts. However, in order to get feedback from supervisors about the interview process and enhance the quality of the data gathered for academic purposes, the principal researcher transcribed the transcripts of the first to fourth

interviews and discussed these with the supervisors before proceeding to the following interviews (McNair et al., 2008). Subsequent to transcribing the interviews, thematic analysis was conducted according to the six analysis phases recommended by Braun and Clarke (2006) guidelines. These six phases were: data familiarisation, creation of preliminary codes, identifying themes, evaluating themes, describing and labelling themes within a code book and production of the report. Table 4 presents a summary of Braun and Clarke's (2006) phases. The study worked on the underlying assumption that qualitative analysis strategies are not rules and can therefore be undertaken with a degree of flexibility in order to answer the research questions (Braun and Clarke, 2006) .

Generally, both deductive (mainly derived from theory) and inductive (mainly derived from data) methods were employed when analysing the interview transcripts (Gale et al., 2013). Morrow (2007) proposed that a qualitative research approach uses inductive approaches from the research questions, instead of hypothesis and assumptions. The inductive approach is a bottom-up approach to build knowledge through highlighting the observations of the world to create hypothesis and theories. In contrast, a deductive approach follows a top-down approach by testing theories or hypothesis against observations alongside an opinion which either confirms or negates those (Ritchie et al., 2013). However, there is an argument that both induction and deduction approaches do not support in answering the research questions and do interpretations in the qualitative research (Ritchie et al., 2013). Furthermore, Ritchie et al. (2013) have argued that the theories and hypothesis creating initial quantitative thoughts are built by using induction techniques. Whereas, qualitative methods gains validity by employing many elements, such as: triangulation of methods and results, clinical significance, detailed data analysis and transferability as well as reflexivity in a particular sampling limits (Malterud, 2001). This view is confirmed by Gale et al. (2013) in their argument which asserts that using

both inductive and deductive approaches can be used to achieve the research aim and objectives.

Table 12: The Thematic Analysis Phases, adapted from Braun and Clarke (2006)

Phase 1: Data Familiarisation	The researcher read the content in depth to familiarise herself with the data. He/she actively re-read it to search for meanings; took notes or marked ideas for coding that were referred to in subsequent stages. The researcher read the transcripts when they listened to the recordings. According to threads and patterns that emerged from the data, a list of preliminary ideas were formed.
Phase 2: Creation of Preliminary Codes	In the coding process, the data were assigned to meaningful groups. The preliminary codes were arranged into possible broader themes. This was achieved both manually and through specific software. The manual generation of preliminary codes was performed with coloured or highlighter pens to denote possible patterns. The code generation software tagged and named portions of the text in every data item to generate codes. This process enabled the initial coding and collation of data, which provided the research with an extensive list of distinct codes that were determined from the entire data set.
Phase 3: Identifying Themes	In this stage, the analysis was re-focused at the wider level of themes instead of codes, whereby various codes were arranged into possible themes, then coded data extracts deemed to have relevance were clustered into determined themes. Codes were also analysed and how distinct codes could be combined to generate an overarching theme were considered. The link between codes, themes and different theme levels was evaluated, subsequently being arranged into primary themes and sub-themes. This stage was completed by collecting potential themes and sub-themes, as well all associated data extracts.
Phase 4: Evaluating Themes	This stage involved the assessment of internal heterogeneity and external homogeneity. It is important that data contained in themes has meaningful coherence for internal homogeneity to be achieved. Additionally, themes must be clearly differentiated from each other for external homogeneity to be established. In this stage, themes were reviewed and then refined.
Phase 5: Describing and Labelling themes	In this phase, the researcher defined and further refined the themes by identifying the essence of each theme (as well as the themes, overall) and determined what aspect of the data each theme captured. For each individual theme, the researcher reviewed names and definitions in order to ensure whether these themes generate clear names and definitions. Finally, the themes were cross checked by the supervisors.
Phase 6: Production of Report.	In this stage, the researcher produced a brief, legible, non-repetitive, rational and engaging account of the story presented in and across all themes.

4.6.5 Quality and Rigour in Qualitative Research

A study conducted using a qualitative research approach achieves validity through elements such as triangulation of methods and findings, attention to destructive cases, validation of responses, detailed analysis of data obtained using various collection methods, reflexivity and transferability within specific sampling limits (Malterud, 2001). Importantly, trustworthiness is vital in qualitative data analysis for its worth and quality to be determined (Lincoln and Guba, 1985). This involves ensuring that it is credible, transferable, reliable and confirmable (Lincoln and Guba, 1985). Therefore, the rigour of the qualitative research was assessed by credibility, transferability, dependability and confirmability. Table 13 describes all these elements and summarises the approaches used to meet these criteria.

4.6.5.1 *Credibility (Internal Validity)*

Credibility in qualitative research is associated with the notion of internal validity (Morse, 2015; Lincoln and Guba, 1985). It describes the extent to which the research is representative of the participants, data and phenomenon being investigated (Morse, 2015). Furthermore, the primary focus is on the richness of the data and not the quantity (Morse, 2015).

Credibility can be demonstrated using different approaches such as continual observation, extended engagement with participants, time spent sampling, triangulation, respondent validation and peer debriefing (Morse, 2015; Lincoln and Guba, 1985). In order to enhance the credibility of the research, several different approaches have been adopted, such as prolonged engagement, triangulation and peer debriefing.

Prolonged engagement with participants is suggested to gain their confidence and build a rapport between the researcher and participants (Hadi and Closs, 2016). This method enables the researcher to obtain more detailed information and thoroughly investigate the research phenomenon (Hadi and Closs, 2016). To gain confidence and build a rapport with the

participants, the PR conducted the intervention, performed the qualitative interviews and engaged in weekly educational activities for nurses as part of the data collection process. Developing an affinity between the PR and participants was accomplished through an initial formal meeting, making it possible to increase engagement between the PR and the participants while maintaining the trust in this relationship. In addition, the PR made informal visits to all rehabilitation hospital wards, attending morning shift interviews to discuss the research process, building a good relationship with nursing staff and becoming more aware of their culture and context. Furthermore, the PR was available during the recruitment process to answer any questions related to the research process or LBP intervention which was separate from the study to help build good relationships with the nursing staff. Therefore, the PR has spent adequate time familiarising herself with the research context and nursing staff.

Triangulation is seeking various sources of information or using different data collection methods (observation, documentation and interview) to gather evidence related to the same phenomenon. This builds good data quality and makes qualitative research more credible (Hadi and Closs, 2016; Morse, 2015). The triangulation approach was used in this trial to ensure validity by eliminating researcher bias and focusing on matters such as reproduction and a lack of generalisation (Lincoln and Guba, 1985). The study used an MMR approach as well as different sources of data. In this approach, two or more associated sources of data gathering techniques or research approaches are used for the purpose of answering a single research question (Morse, 2015). Data triangulation has been applied by using nurses with and without LBP to improve research quality. Additionally, data were cross-checked when analysing and interpreting the data. The participants were also encouraged to be frank at the beginning of each interview, and it was made clear that there were no right or wrong answers. (Creswell and Poth, 2016).

Peer debriefing is the method of seeking an external review with an individual who is familiar with the study (Creswell and Poth, 2016). When applying peer debriefing, the PR continually consulted with their peers regarding methodology, data analysis and subsequent interpretation (Hadi and Closs, 2016). In the context of this study, peer debriefing and regular supervision meetings were conducted during data collection, either face-to-face or via Skype, WhatsApp or email. The supervisors' views helped explore additional perspectives and explanations and stimulate consideration at different data collection and analysis stages.

Furthermore, the PR had an opportunity to discuss different aspects of the research process with other experts from academia. The study was presented in many research activities in the UoN and international conferences, which shared aspects and views of the research with others for critical feedback. Critical questions that followed the presentations allowed critical thinking and highlighted certain aspects of the study to be improved. Respondent validation was suggested to increase the credibility of qualitative research (Torrance, 2012). This can be implemented during the entire data collection process to verify whether the researcher has correctly understood and interpreted the participants' responses to ensure reliability of the results (Morse, 2015; Lincoln and Guba, 1985b). It should be noted that respondent validity was not administered during this trial due to the time limitations of the study and the weak postal service in the KSA.

4.6.5.2 Transferability (External Validity)

Transferability refers to the extent to which the research findings can be applied in different contexts where an identical phenomenon exists (Morse, 2015; Lincoln and Guba, 1985). In the context of qualitative research, transferability is associated with the notion of external validity. It is asserted that transferability can be accomplished by ensuring the research context is sufficiently described (Morse, 2015; Lincoln and Guba, 1985). This implies that the researcher

must provide adequately detailed information regarding settings, sample attributes, exclusion/inclusion criteria and the methods used to collect and analyse the data (Hadi and Closs, 2016). This trial may present a challenge in combining the results and conclusion with other populations in different contexts. Thus, to address this challenge, the recording and collection of data were discussed in detail as it pertained to the methods of data collection, participants' characteristics and time allocated for data collection.

It is possible to use a purposive sampling approach to obtain detailed information regarding the group of individuals affected by the given phenomenon (Hadi and Closs, 2016). However, considering the tendency to recruit a small sample during qualitative research and the objective of not generalising the findings, the contextual factors remain critical to the reader, based on their relevance to the setting (Bryman, 2016). In this research, transferability was ensured by adopting a purposive sampling approach (Farrugia, 2019). This was used to select nurses with and without an LBP history, working within different departments in the Rehabilitation Hospital and from different age groups. In addition, they engaged with the WBI-BACK programme differently. The PR also provided rich descriptive data such as the research context, setting, sample size and strategy, inclusion and exclusion criteria, demographic data and interview methods. As a result of providing this data, future research will be better able to determine whether the study findings are applicable in other contexts and settings (Morse, 2015).

4.6.5.3 *Dependability*

In the context of qualitative research, dependability refers to the consistency of the findings, and whether the same findings would be produced if a different study was conducted in a similar context (Lincoln and Guba, 1985). It is associated with the notion of reliability in quantitative research (Morse, 2015; Lincoln and Guba, 1985). Through this technique, different approaches can be employed to show dependability such as external audits, triangulation,

stepwise replication, respondent validation, peer examination or the code–recode process (Hadi and Closs, 2016; Lincoln and Guba, 1985). In the context of this research, dependability was ensured through supervision meetings, conduct external reviewers and triangulation. The PR verified results by including the main supervisors and one clinical researcher in the same study field. The triangulation method was also followed for verifying results by using multiple information sources (including literature) and obtaining observations from various inquiries (Salkind, 2010). This was essential to confirm that no data was missing in this study, and to avoid any interpretation bias based on individual preference and viewpoints. A comparison was made between the results drawn from the perspectives of the two groups of respondents (nurses with and without a history of LBP) when analysing the data to ensure that results were produced and compared from both sources.

4.6.5.4 *Confirmability*

Confirmability denotes the extent to which findings are logically supported by the data collected (Morse, 2015). In the context of qualitative research, it is associated with the notion of objectivity in quantitative research (Morse, 2015; Lincoln and Guba, 1985). Various approaches have been recommended to establish confirmability in qualitative research such as an audit trail, reflexivity, triangulation and external review (Lincoln and Guba, 1985). In this research, confirmability was achieved using open coding and categories, instead of coding that had been pre-determined. Furthermore, quotations from multiple interviews were included in results as illustrations within different categories. Additionally, the data collection and analysis processes were externally reviewed during supervision meetings to ensure confirmability.

Table 13: Summary of Interventions to Determine Trustworthiness

Trustworthiness Elements	Definition	Strategies employed to satisfy criteria
Credibility	Linked to how well the research illustrates the participants, data and actual phenomenon under deliberation.	• Prolonged engagement • Triangulation • Peer debriefing
Transferability	How the research results can be applied in other research contexts where the same phenomenon is presented.	• Detailed documentation of data collection methods, participants' characteristics as well as the timing of data collected. • A purposive sampling strategy
Dependability	Confirming that the results from this study can be consistent and similar when conducting another study in a similar context.	• Supervision meetings • Triangulation
Confirmability	Whether the results from the study based on the data collection are logical.	• External review • Data analysis reviewed by the supervision meetings

4.6.6 Reflexivity and Administration of Data Collection

Reflexivity can be delineated as how the researcher reflects on the research process and outcomes in a particular political, social, linguistic and cultural context (Alvesson, 2002). Reflexivity has been suggested as a skilled means of interpreting results using both knowledge and data gathering (Alvesson and Sköldberg, 2017). One of its tools is reciprocity in qualitative research interviews (McNair, Taft and Hegarty, 2008). Reciprocity is a reflexive method in which the researcher shares thoughts, feelings and experiences with the interviewee (McNair

et al., 2008). Understanding the possible effects of the nurses' assumptions and thoughts during the interviews and interpreting the results are considered useful in overcoming pitfalls (Dodgson, 2019). Significantly, the PR was aware that her enthusiasm and interest could affect values and outcomes, particularly as she was a previous staff member in the Rehabilitation Hospital working as a physiotherapist. Therefore, the PR held a variety of assumptions regarding nurses' clinical and cultural contexts and backgrounds based on experience and practice. For example, the PR reassured the nurses there was no risk regarding their job or salary when they participated. This avoided embarrassment and hesitation for them in expressing their opinions. However, most nurses were not aware of the research method, as KFMC is not a university hospital. Also, the qualitative approach is not a standard method typically used in research contexts in the KSA, and many nurses were not familiar with the concept of the interviews. Therefore, the PR explained the research process and data collection to all nurses, ensuring the nurses understood they could withdraw from the study at any time without giving any reasons. Their participation or non-participation would not affect their job at KFMC. The PR is currently working as a lecturer at the university; a factor which may have helped the nurses recruited to the study express their thoughts and opinions more freely.

Reflexivity should be continued through all research phases and can be maintained by regular supervision meetings. The supervisory team reviewed the early interview transcripts to identify the interviewing skills which needed modification to enhance reflexivity and improve the rigour of data collection (McNair et al., 2008). This study holds that a researcher must be aware of their thoughts and interpretations throughout all research processes.

After data collection, the PR was responsible for data entry. Each participant was assigned a unique study identity code. The researcher made a confidential record of the participant's name to document identification of all participants in the study, in case additional follow-up was required. The administrative procedures relating to the storage of information and

confidentiality were applied. Study forms were treated as confidential documents and held securely in accordance with ethical regulations.

4.7 Data Synthesis (Triangulation)

Quantitative and qualitative data were collected simultaneously and analysed separately in Chapters 5 and 6, (see Figure 15). The integration process included combining numeric information from the quantitative data with the texts from the qualitative data. Integration was achieved through reporting results together in the process of evaluation of the feasibility study (Chapter 7) and assessed through predetermined progression success criteria related to recruitment and retention rate, completeness of outcome measures, exposure to the intervention and acceptability of the intervention (Herbert, Julious and Goodacre, 2019; Hawkins et al., 2017). In order to assess the progression success feasibility criteria, the data from quantitative and qualitative results were then combined to provide further detail and highlight possible findings. In total, 5 predetermined progression success criteria were developed by the PR, informed by the methodological literature (Noblet, Marriott and Rushton, 2019; Sharma et al., 2018; Orsmond and Cohn, 2015; Tickle-Degnen, 2013 ; Bowen et al., 2009) and agreed by the main supervisors. The decision of success criteria was based on the following traffic light assessment system: 1) Red = stop: discontinue a full study if any pre-planned changes could not help promote feasibility; 2) Amber = amend: modify the study protocol further before conducting a full study without another feasibility assessment, 3) Green = proceed: continue to a full study as it is in the feasibility study without amendments (Hawkins et al., 2017; Abbott, 2014). Table 14 shows the summary of progression criteria, their measurement and assessment. The data were ordered thematically, outlining both quantitative and qualitative data sets, to give insights into quantitative feasibility measures and qualitative understanding of the facilitators and barriers from various perspectives, before all facets of progression criteria and decision making on progressing were presented (See Chapter 7).

Table 14: Summary of Success Progression Criteria

Progression Criteria	The design of the full study is not feasible (Red = Stop)	Modify the study protocol further before conducting a full study without another feasibility assessment (Amber = Amend)	Continue to a full study without amendments in the feasibility study protocol (Green = Proceed)
1- Recruitment rate	< 2 participants every week for 12 weeks	2- 3 participants recruited every week for 12 weeks. -Considering the representativeness of the sample and possible steps to increase recruitment. -Finding the reasons and barriers causing low participation recruitment rates or declining participation. -Potential strategies might include changing or increasing the number of study sites, or promoting advertising efforts for recruitment participation.	≥ 4 participants recruited every week for 12 weeks. -The total recruited number will be 40-50 participants.
2- Attrition rate	> 30% of total withdraw post intervention.	15%-30% of total withdraw post intervention. -Find possible causes for withdrawals, and strategies to enhance follow-up participation and retention rate.	< 15% of total withdraw post intervention.
3- Feasibility of outcome measures assessment	> 20% of missing data on the secondary outcome measures.	10% -20% of missing data on the secondary outcome measures. -Modify the number of outcome measures questionnaires required.	< 20% of missing data on the secondary outcome measures.
4- Intervention Engagement	< 50% of participants engage with the WBI-BACK intervention programme at least once per week and maintain their records of weekly PA in the PA diary sheets.	50%- 80% of participants engage with the WBI-BACK intervention programme at least once per week and maintain their records of weekly PA in the PA diary sheets. - Find the reasons for non-engagement in order to enhance engagement with the WBI-BACK intervention programme for the full study. -Identify the reasons why participants do not maintain adequate records for PA and set their goals in the PA diary sheets. -Identify barriers and facilitators for intervention engagement.	> 80 of participants engage with the WBI-BACK intervention programme at least once per week, maintain a record of weekly PA and set their goals in the PA diary sheets.
5- Experience of the	< 50% of participants rate the perceived ease of use,	50% - 80% of participants rate the perceived ease of use, usefulness	> 80 % of participants rate the perceived ease of

intervention components based on the Technology Acceptance Model (TAM)	acceptability and had positive attitude to the use of the WBI-BACK intervention programme as mostly agree and strongly agree scores.	and had positive attitude to the use of the WBI-BACK intervention programme as mostly agree and strongly agree scores. -Make WBI-BACK intervention programme easier and more acceptable to the participants. -Reduce the complexity of the programme and reevaluate it to ensure suitable levels of difficulty.	use, usefulness and had positive attitude to the use of the WBI-BACK intervention programme as mostly agree and strongly agree scores.
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4.8 Ethical Considerations

It is essential to address ethical considerations when conducting a study on humans. This study is considered a low-risk study. However, several issues were of concern when participants were undertaking exercise activities. Therefore, all recommended exercises and activities (walking or back exercises) were explained in detail, emphasising choosing a comfortable level for the participants. Participants were selected at a convenient time for themselves, and they understood that they had the right to withdraw from the study at any time they deemed necessary. Anonymity, confidentiality and the privacy of participants were ensured.

4.8.1 Ethical Approval Process

Ethical approval from the present study was obtained from the Research Ethics Committee of the Faculty of Medicine and Health Science Research Ethics Committee at the UoN (Ref: 307-1904) and from the Chairman Institutional Review Board (IRB) at KFMC in Riyadh, KSA (IRB-Log Number: 19-336E; Appendix 12). Furthermore, additional approval was obtained from the Chairperson of the Nursing Research Committee at KFMC in Riyadh, KSA. (See Appendix 12).

4.9 Confidentiality and Data Protection

Confidentiality was addressed by maintaining anonymity throughout the research process. This was achieved by holding the consent forms and individual demographic characteristics separately. Additionally, participants' names were coded uniquely in the quantitative and qualitative data sets.

The PR was the only person with access to all participants' data. Research data from this study will be maintained for a minimum of seven years, and then the data will be destroyed after the end of the study. All electronic data from the Jisc online survey, audio files and interview transcripts were made anonymous and stored in password-protected computers for the PR. The consent form documents, and other information collected during the data collection period are kept in a securely locked office. The data was utilised for academic purposes only such as supervision meetings, discussions and conferences.

4.10 Chapter Summary

This chapter outlined the methods employed to attain the study's aim and objectives. The study purpose was to assess the acceptability and feasibility of the WBI-BACK intervention programme developed to promote self-management of LBP in nurses working in the KSA. The MMR strategy was realised by collecting both quantitative and qualitative data concurrently, each of which were analysed independently. Key criteria for progression to a full-scale study will be assessed to inform the future definitive RCT. The following chapters will demonstrate the results from both the quantitative and qualitative analysis explained in this chapter.

Chapter 5: Quantitative Results

5.1 Introduction

The previous chapter presented the methodology of the current study to assess the feasibility of the WBI-BACK intervention programme for nurses working in Saudi hospitals. This chapter will present the quantitative results of the study.

5.2 Baseline Demographic Characteristics of Sample

Baseline demographic data was collected from 53 participants (35 with LBP and 18 with NOLBP), and only 45 participants (30 with LBP and 15 with NOLBP) completed the full trial and were included in the final analysis. The demographic characteristics of the 45 participants in the LBP and NOLBP groups are shown in Table 15. The groups were equivalent in terms of gender distribution; 73 % females and 27% males for both groups. The nationality of the majority of sample participants was Filipino, accounting for 83% in the LBP group and 67% in the NOLBP group. 10% and 27% were of Saudi nationality in the LBP and NOLBP groups respectively. There was one Jordanian and one Indian national in the LBP group, compared to one Indian national in the NOLBP group.

The minimum age was 23 and 22 years in the LBP and NOLBP groups respectively, while the maximum age was 50 years in both LBP and NOLBP groups. The LBP participants had a mean age of 33 years, whereas the NOLBP participants had a mean age of 30 years. Furthermore, 19 (63%) of participants in the LBP group had served between one and 10 years in nursing in the LBP group, whereas 13 (87%) participants in the NOLBP group had served between one and 10 years. The representativeness of the sample will be discussed later in the discussion chapter.

Table 15: Participants' Demographic Characteristics

Sample Characteristic N=45	*LBP Group N=30	*NOLBP Group N=15
All participants	N=30 (67%)	N=15 (33%)
Age		
20–29 Years	7 (23)	9 (60)
30–39 Years	19 (63)	5 (33)
40–50 Years	4 (13)	1 (7)
Gender		
Female	22 (73)	11 (73)
Male	8 (27)	4 (27)
Work Experience		
1–10 Years	19 (63)	13 (87)
11–20 Years	9 (30)	1 (7)
21–30 Years	2 (7)	1 (7)
Nationality		
Filipino	25 (83)	10 (67)
Saudi	3 (10)	4 (27)
Indian	1 (3)	1 (7)
Jordan	1 (3)	
Employment Status		
Registered nurses	24 (80)	13 (87)
Nursing administration	4 (13)	1 (7)
Intern	2 (7)	1 (7)

Note: Numbers are counts and percentages

LBP Group=Lower Back Pain Group

NOLBP Group=No Lower Back Pain Group

5.3 Results from Primary Feasibility Outcomes

5.3.1 Recruitment and Response Rate

Participants were recruited from the KFMC's Rehabilitation Hospital in Riyadh, KSA. There were around 206 nurses working in the Rehabilitation Hospital during the study period. A convenience sample approach was used to recruit the highest sample variation in the study (Etikan,Musa and Alkassim, 2016; Mason, 2010). A convenience sample of participants was

recruited from the nursing population of this department. The recruitment process started on 1st October 2019, ending on 30 December 2019. The PR approached 80 participants who were invited to take part in the study. Of those 80 participants, only 62 (77.5 %) agreed to participate in this study. Fifty-three (66.2%) participants were found to be eligible after the inclusion and exclusion criteria were applied which has been described in Chapter 4 (Section 4.4.1). The reasons for exclusion included two participants being pregnant, another four being unable to access the Internet at home and the last three being contraindicated to undertaking PA based on their response to the PAR-Q. The 53 participants were allocated into one of two groups, based on whether they had reported a presence of current LBP or not (as defined in the participant flow diagram in Figure 17). Recruited participants were requested to complete a set of initial online self-reported questionnaires, and all 53 participants (100%) completed these questionnaires.

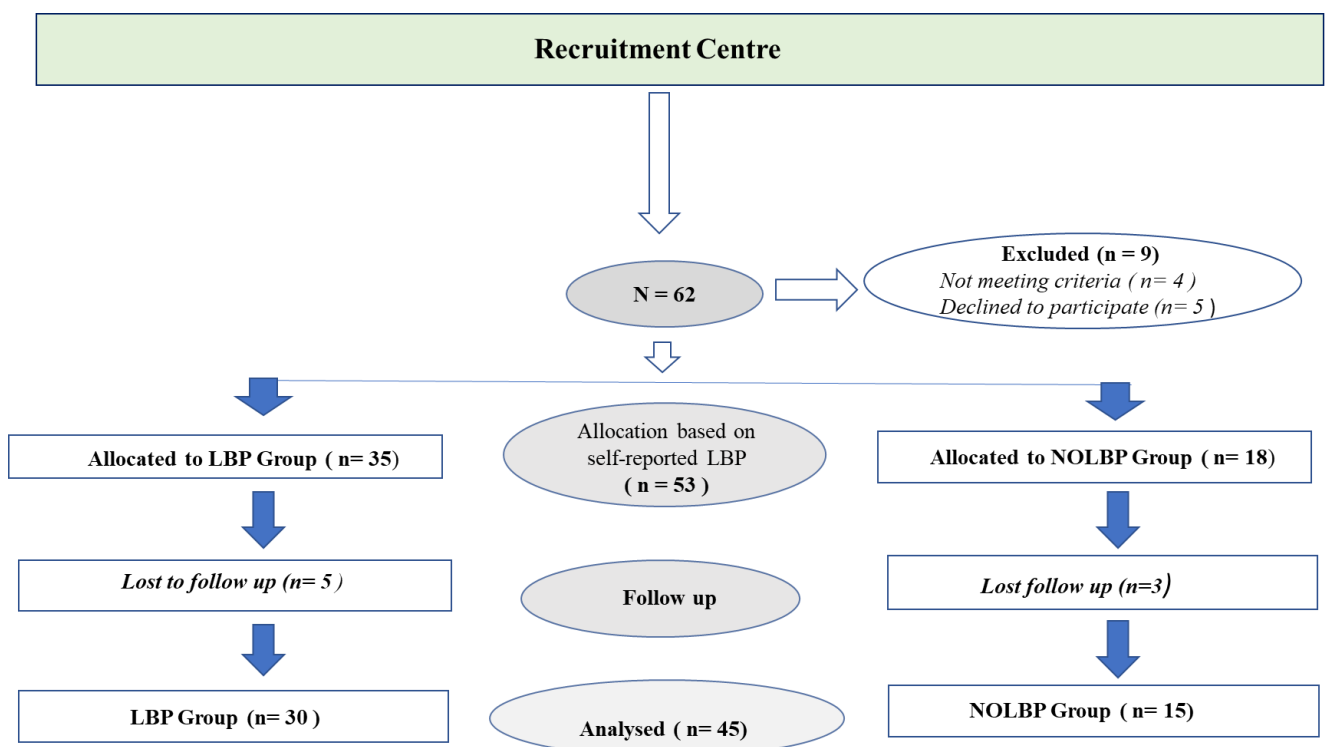


Figure 17: Participants' Flow Diagram

5.3.2 Follow-up

Of the 53 participants who agreed to participate, 45 (85%) completed the six-week trial. The follow-up rate from the questionnaire was 86% (30/35) for the LBP group and 83% (15/18) for the NOLBP group. Eight nurses did not respond for post-intervention data collection and were consequently withdrawn from the data analysis due to the unavailability of their data. Specifically, one nurse left the KFMC hospital, two nurses were on an extended annual leave at the time of follow-up and were not to be approached, and five did not respond to their emails to fill out the post-intervention outcome measure questionnaires. The overall loss to follow-up post-intervention was 15% in both groups.

5.3.3 Intervention Fidelity Assessment

MRC guidelines recommended intervention fidelity when designing and evaluating a complex intervention (Craig et al., 2008). Intervention fidelity is defined as the use of standardised methodological approaches to monitor and enhance the reliability and validity of behavioural intervention programmes (Mars et al., 2013). The fidelity assessment was used as the measure to which the intervention was delivered as planned, as documented in the research protocol (fidelity of delivery), and participants engaged in all content during the initial meeting (fidelity of engagement). Fidelity of delivery was assessed as follows: (1) All participants received a link to the WBI-BACK intervention programme during the initial interview, (2) Participants had face-to-face checks to ensure that they had a link to the WBI-BACK intervention programme and could access this intervention; (3) Participants received information on how to use the WBI-BACK intervention programme online either on their computers or mobile phones, and received a physical activity diary sheet to set their weekly goals during the initial interview, (4) Participants received a weekly reminder email for six weeks, including the link to the WBI-BACK intervention programme, to encourage participation, (5) Participants

received two invitation emails to attend lectures and workshops to familiarise them with the WBI-BACK programme and; 6) Participants received a soft copy of the lectures given by the principal researcher through their registered email.

Nevertheless, subsequent chapters of this thesis will discuss the lessons learned from conducting this study, its limitations and implications for future research.

5.3.4 Missing Data

The data of eight participants was not included in the data analysis files due to incomplete responses (Bennett, 2001). All returned questionnaires were checked electronically through the JISC online survey for missing data. In cases where information was missing, the participant could not submit the form, and a dialogue error box would pop up on the screen. The researcher was contacted as soon as the error screen was generated, and they would chase up the missing information with the participant, asking them to complete the missing questions. Moreover, the nature of the outcome measures questionnaires depended on the sum of responses for each participant, and no missing data was observed.

5.3.5 Intervention Engagement

Evidence recommends that the engagement level is essential for complex intervention effectiveness, while it is unclear how to conceptualise engagement in certain interventions (Perski et al., 2017). The system usage data in mHealth and eHealth interventions are the most common methods to collect and report measures of engagement (Perski et al., 2017), whereas self-reported questionnaires can be used to examine the level of engagement in digital health interventions (Short et al., 2018). In this study, the level of engagement was assessed through self-reported post-intervention questionnaires and maintaining a record of PA using a diary sheet during the intervention period of six weeks. The generated response of the engagement

level in the WBI-BACK intervention programme was categorised as accessed once, twice or three times each week, and computed as the proportion of participants (n (%)) in both LBP and NOLBP groups (see Table 16). The overall engagement in the WBI-BACK intervention programme was acceptable. Forty participants in all groups (89%) engaged in the WBI-BACK intervention programme; 22 participants (49%) engaged once per week, 13 participants (29%) engaged twice, and 5 participants (17%) engaged three times or more, while 5 participants (11%) failed to engage in the WBI-BACK intervention programme (Figure 18). Many of the participants accessed the WBI-BACK intervention programme from home, accounting for 73% and 60% in both LBP and NOLBP groups respectively, whereas a quarter of them engaged in the intervention from their work, representing 23% and 33% respectively for the LBP and NOLBP groups (Figure 19). However, none of the participants in LBP and NOLBP groups maintained their record of weekly physical activity in their diary sheet.

The data usage for the WBI-BACK intervention programme was also collected by recording the number of WBI-BACK programme plays for the intervention package through the XERTI programme, which indicates the number of engagements by all participants. The data was recorded five times through the XERTI programme during the intervention period for six weeks (see Appendix 13). At the end of the intervention period, there were 173 plays (recorded on 30 January 2020), which reflected good access to the WBI-BACK intervention programme by all nurses.

Engagement was also indicated by the percentage of the participants who accessed the different modules in the WBI-BACK intervention programme through the Jisc online survey after collection of the post-intervention outcome measures. Educational and exercise modules were the most used by the participants in both LBP and NOLBP groups (see Table 17). Of the 40 participants who engaged in the WBI-BACK intervention programme, 27 (96 %) and 10 (83 %) engaged in the educational and exercise modules in both groups respectively. Engagement

in the PA module was 86 % in the LBP group and 83 % in the NOLBP group, while the psychological module had less engagement, with 25 % in the LBP and 17 % in the NOLBP groups.

Table 16: Participants' Intervention Engagement

All Participants N= (45)			
Access to the WBI-BACK Programme	LBP Group N=30	NOLBP Group N=15	Total N=45
Access Once /Week	13 (43 %)	9 (60 %)	22 (49 %)
Access Twice /Week	10 (33%)	3 (20 %)	13 (29 %)
Access Three times or more /Week	5 (17 %)	0	5 (17 %)
Total Access Among Group	28 (93 %)	12 (80)	40 (89 %)
Not Access	2 (7 %)	3 (20 %)	5 (11 %)

Note: Numbers are counts and percentages

LBP Group=Lower Back Pain Group

NOLBP Group=No Lower Back Pain Group

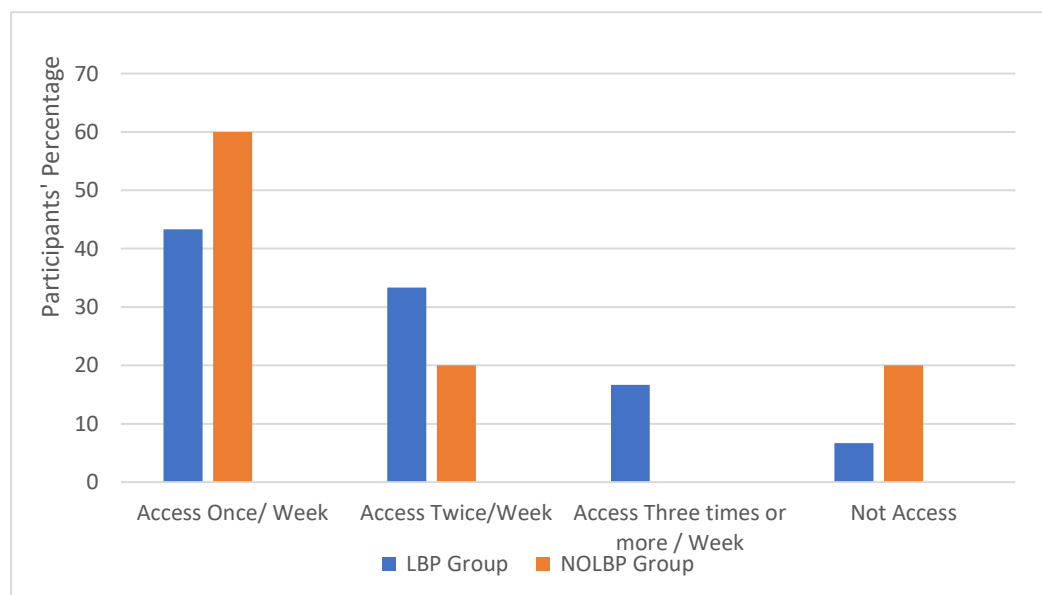


Figure 18: Participants' Engagement with the WBI-BACK Programme

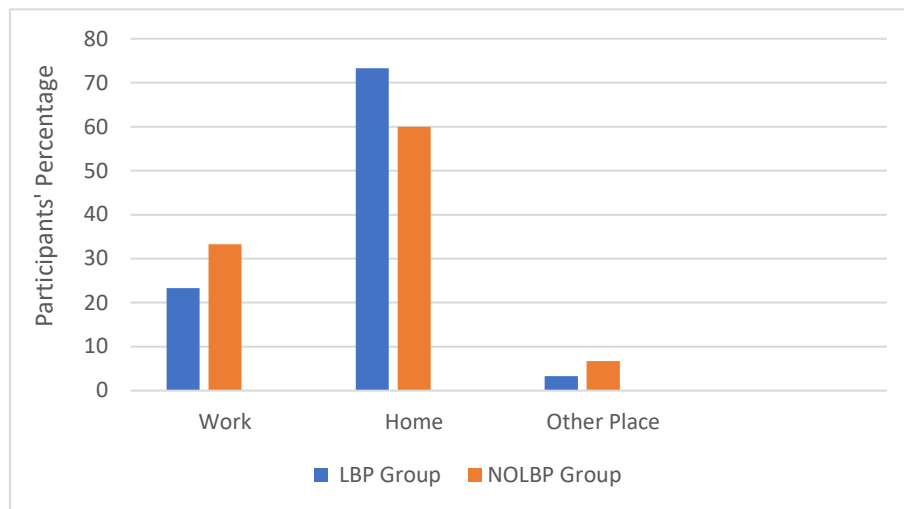


Figure 19: Participants' Place Used for Accessing WBI-BACK Programme

Table 17: Modules' Engagement in the WBI-BACK Programme

All Participants N= (40)		
WBI-BACK Modules	*LBP Group (N=28)	*NOLBP Group (N=12)
1- Educational Module		
Access	27 (96 %)	10 (83 %)
No Access	1 (4 %)	2 (17 %)
2- Exercise Module		
Access	27 (96 %)	10 (83 %)
No Access	1 (4 %)	2 (17 %)
3- Physical Activity Module		
Access	24 (86 %)	10 (83%)
No Access	4 (14 %)	2 (17 %)
4- Ergonomics Module		
Access	23 (82 %)	8 (67 %)
No Access	5 (18 %)	4 (33 %)
5- The Psychological Module		
Access	7 (25 %)	2 (17 %)
No Access	21 (75%)	10 (83 %)
6- Healthy Lifestyle Module		
Access	8 (29 %)	3 (25 %)
No Access	20 (71 %))	9 (75 %)

Note: Numbers are counts and percentages

***LBP Group**=Lower Back Pain Group

***NOLBP Group**=No Lower Back Pain Group

5.3.6 Intervention Experience Based on TAM

Experience of the intervention for the participants was assessed based on their responses to TAM questionnaires (Table 18, 19, 20). The questions were based on ease of use, usefulness and attitude to the use of the WBI-BACK programme. Answers to these questions were completed on a five-point categorical scale (1 = strongly agree, 2 = mostly agree, 3 = don't know, 4 = mostly disagree, and 5 = strongly disagree). More than 80 % of participants reported that the WBI-BACK intervention programme was easy to use, useful and had positive attitudes and knowledge of the WBI-BACK intervention.

Table 18: Experience of Intervention Components based on TAM (Perceived Ease of Use) for both LBP and NOLBP Groups

Feasibility Outcomes	LBP Group (N=35) N (%)	NOLBP Group (N=15) N (%) or Mean (SD)
a- Easy to Use		
• Strongly agree	19 (63%)	5 (33 %)
• Mostly agree	7 (23%)	8 (53%)
• Total	*26 (86%)	*13 (86%)
• Don't know	3 (10%)	2 (13.3%)
• Mostly disagree	0	0
• Strongly disagree	1 (3.3%)	0
• Total	**4 (13.3%)	**2 (13.3%)
b- Content of WBI-BACK Programme was clear and understandable		
• Strongly agree	20 (66.7%)	5 (33 %)
• Mostly agree	6 (20%)	8 (53%)
• Total	*26 (86%)	*13 (86%)
• Don't know	3 (10%)	2 (13.3%)
• Mostly disagree	1 (3.3%)	0
• Strongly disagree	0	0
• Total	**4 (13.3%)	**2 (13.3%)
c- Information in WBI-BACK Programme was comprehensible		
• Strongly agree	16 (53.3 %)	7 (46.7%)
• Mostly agree	10 (33.3%)	7 (46.7%)

• Total	*26 (86%)	*14 (93.4 %)
• Don't know	3 (10%)	1 (6.7%)
• Mostly disagree	0	0
• Strongly disagree	1 (3.3%)	0
• Total	**4 (13.3%)	**1 (6.7%)
d- Navigation around the WBI-BACK Programme was easy and intuitive		
• Strongly agree	17 (56.7%)	6 (40%)
• Mostly agree	9 (30 %)	8 (53%)
• Total	*26 (86%)	*14 (93.4 %)
• Don't know	3 (10%)	1 (6.7%)
• Mostly disagree	1 (3.3%)	0
• Strongly disagree	0	0
• Total	**4 (13.3%)	**1 (6.7%)

*The feasibility criteria were met (≥ 80 % of participants perceived ease of use)

**This include the response from non-engagement participants in both the LBP and the NOLBP groups

Table 19: Experience of Intervention Components based on TAM (Perceived Usefulness) for both LBP and NOLBP Groups

Feasibility Outcomes	LBP Group (N=35) N (%)	NOLBP Group (N=15) N (%) or Mean (SD)
a- The WBI-BACK programme helped me to self-manage my LBP		
• Strongly agree	17 (56.7 %)	6 (40%)
• Mostly agree	9 (30 %)	8 (53%)
• Total	*26 (86%)	*14 (93.4 %)
• Don't know	3 (10%)	1 (6.7%)
• Mostly disagree	0	0
• Strongly disagree	1 (3.3%)	0
• Total	**4 (13.3%)	**1 (6.7%)
b- WBI-BACK Programme provided useful and sufficient knowledge to manage my back pain		
• Strongly agree	19 (63%)	7 (46.7 %)
• Mostly agree	7 (23%)	7 (46.7 %)
• Total	*26 (86%)	*14 (93.4 %)
• Don't know	3 (10%)	1 (6.7%)
• Mostly disagree	0	0
• Strongly disagree	1 (3.3%)	0
• Total	**4 (13.3%)	**1 (6.7%)
c- WBI-BACK programme improved my self-confidence to manage my back pain		

- Strongly agree - Mostly agree Total - Don't know - Mostly disagree - Strongly disagree Total	19 (63%) 7 (23%) *26 (86%) 3 (10%) 0 1 (3.3%) **4 (13.3%)	6 (40%) 7 (46.7 %) *13 (86.7 %) 2 (13.3 %) 0 0 **2 (13.3 %)
d- Using the WBI-BACK programme helped improve my job performance		
- Strongly agree - Mostly agree Total - Don't know - Mostly disagree - Strongly disagree Total	19 (63%) 7 (23%) *26 (86%) 3 (10%) 0 1 (3.3%) **4 (13.3%)	5 (33 %) 9 (60 %) *14 (93.4 %) 1 (6.7%) 0 0 **1 (6.7%)
e- I would recommend the WBI-BACK to others to help self-management of LBP		
- Strongly agree - Mostly agree Total - Don't know - Mostly disagree - Strongly disagree Total	20 (66.7 %) 6 (20%) *26 (86%) 3 (10%) 0 1 (3.3%) **4 (13.3%)	6 (40%) 7 (46.7 %) *13 (86.7 %) 2 (13.3 %) 0 0 **2 (13.3 %)

*The feasibility criteria were met (≥ 80 % of participants perceived usefulness)

**This include the response from non-engagement participants in both the LBP and the NOLBP groups

Table 20: Experience of Intervention Components based on TAM (Attitude and knowledge to use) for both LBP and NOLBP Groups

Feasibility Outcomes	LBP Group (N=35) N (%)	NOLBP Group (N=15) N (%) or Mean (SD)
a- Using the information in the WBI-BACK programme is a good way to manage my back pain		
• Strongly agree	22 (73%)	7 (46.7%)
• Mostly agree	4 (13%)	7 (46.7%)
• Total	*26 (86%)	*14 (93.4 %)
• Don't Know	3 (10%)	1 (6.7%)
• Mostly disagree	0	0
• Strongly disagree	1 (3.3 %)	0
• Total	**4 (13.3%)	**1 (6.7%)
b- I enjoy using the WBI-BACK programme		
• Strongly agree	19 (63.3 %)	6 (40 %)
• Mostly agree	7 (23.3 %)	7 (46.7%)
• Total	*26 (87%)	*13 (86.7 %)
• Don't Know	3 (10%)	2 (13.3 %)
• Mostly disagree	0	0
• Strongly disagree	1 (3.3 %)	0
• Total	**4 (13.3%)	**2 (13.3 %)
c- Using WBI-BACK Programme helped me maintain high level of motivation & adherence to self-managing my LBP		
• Strongly agree	19 (63 %)	7 (46.7%)

• Mostly agree	7 (23 %)	6 (40 %)
• Total	*26 (87%)	*13 (86.7 %)
• Don't Know	3 (10%)	2 (13.3 %)
• Mostly disagree	0	0
• Strongly disagree	1 (3.3 %)	0
• Total	**4 (13.3%)	**2 (13.3 %)
d- I generally have a positive attitude towards using the WBI-BACK programme		
• Strongly agree	19 (63 %)	7 (46.7%)
• Mostly agree	7 (23 %)	6 (40 %)
• Total	*26 (87%)	*13 (86.7 %)
• Don't Know	3 (10%)	2 (13.3 %)
• Mostly disagree	0	0
• Strongly disagree	1 (3.3 %)	0
• Total	**4 (13.3%)	**2 (13.3 %)

*The feasibility criteria were met (≥ 80 % of participants perceived a positive attitude toward the WBI-BACK intervention programme)

**This include the response from non-engagement participants in both the LBP and the NOLBP groups

5.4 Results of Secondary Outcome Measures

The current research used descriptive statistics to report the main features of the data. They provide the summary of the sample and outcome measures. Almost one-half of the statistical tests need to meet one or more assumptions, and any violations to this assumption can produce underestimations or overestimations of the inferential measures and effects (Hoekstra, Kiers and Johnson, 2012). For parametric statistical tests, normality of each variable in outcome measures was assessed by histograms and visual inspection of residues in normal quantile

(Appendix 14). Nonparametric statistical tests were used if data was considered abnormal. Previous studies (Hawkins et al., 2019; Geraghty et al., 2018; Hagen et al., 2011) revealed that the main analysis for the feasibility studies should be descriptive, while the hypothesis needs a powered sample size, which is not usually available in feasibility studies. The statistical analysis plan was discussed with Dr Andera Venn, a statistician in the Medical School (see Appendix 14) and the main supervisors, and they agreed that the plan was suitable for the study purposes and objectives.

5.4.1 Results of Secondary Outcomes for the LBP Group

Paired-sample t-tests were conducted to compare the different scores of self-reported PAs, fear of movement, pain intensity, physical functioning, quality of life and self-efficacy before and after the intervention for LBP group, and quality of life and self-efficacy for NOLBP group, with understanding that the current feasibility study not powered to detect statistically significant. Therefore, treatment effects for the secondary outcome measures were presented as means, SD and confidence interval (CI) of the mean (Sharma et al., 2018). Table 21 presents the pre- and post-scores for PA, fear of movement, pain intensity, physical functioning, quality of life and self-efficacy measures.

5.4.1.1 *International Physical Activity Questionnaire (IPAQ)*

The IPAQ data was transformed into the mean Metabolic Equivalent of Task (MET)-min/week, following the guidelines for data treatment and analysis, as defined in the IPAQ (Forde, 2018), and the mean pre- and post- intervention scores were compared . The results in Table 21 show that the mean of total PA MET-min/week scores for nurses with LBP at baseline was (M = 953.9, SD =1310.2) compared to the MET-min/week scores post-intervention (M =1378.5, SD =1378.5). The mean increase in PA MET -min/ week scores was 424.6; however, a 95% CI ranges from -194.6- to 1043.

The mean score of the moderate physical activity MET-min/week for nurses with LBP after the WBI-BACK intervention programme was ($M = 652.7$, $SD = 811.3$ compared to the mean score at the baseline ($M = 251.3$, $SD = 451.1$), The mean increase in moderate PA scores after web-based intervention was 401.3 with a 95% CI ranging from 37.6 to 765.1.

5.4.1.1.1 *Moderate Physical Activity*

The American Heart Association recommends 450–750 MET-min/week, 30 minutes of moderate exercise for five days a week, or 20 minutes of vigorous exercise activity for three days a week (Bull et al., 2020). The participants were asked how many days (per week) they were physically active at a moderate intensity level for 30 minutes. Moderate PA is defined as any form of activity that causes a small increase in breathing or heart rate (such as brisk walking, cycling, vacuuming, or gardening) (Bull et al., 2020). The proportion of nurses who undertook 30 minutes of moderate PA five days a week after the WBI-BACK intervention programme was 9 (30%), in comparison with the baseline group that had seven nurses (23%) who met the recommendation, as shown in Table 22.

5.4.1.1.2 *Vigorous Physical Activity*

Similarly, the proportion of participants who met vigorous PA guidelines was calculated. Participants were asked how many days per week they were PA at a vigorous intensity level for 20 minutes. Vigorous PA is defined as any form of activity that causes a large increase in breathing or heart rate (such as running, aerobics, or heavy yard work) (Bull et al., 2020). Table 22 shows that the proportion of nurses who undertook 20 minutes of the vigorous physical activity for 2-3 days decreased after the WBI-BACK intervention programme, with three nurses (10%), compared to the baseline of 17 (57%).

Table 21: Outcome Measures for LBP Group

LBP Group (N=30)

Measures	Pre-Intervention Mean (SD)	Post-Intervention Mean (SD)	Differences in Mean Change at 95% CI (SD)	Mean Change 95 % CI)	
				Lower	Upper
**IPAQ –Total	953.9 (1310.2)	1378.5 (1120.3)	424.6 (1658.2)	-194.6-	1043
**IPAQ – Vigorous	289.3 (579.5)	216.0 (347.2)	73.3 (726.3)	-197.9-	344.5
**IPAQ – Moderate	251.3 (451.1)	652.7 (811.3)	401.3 (974.1)	37.6	765.1
**IPAQ – Walking	653.3(1385.8)	509.9 (448.6)	-143.4- (1341.8)	-644.5-	357.6
**IPAQ – Sitting	70.0 (45.8)	30.0 (.0)	- 40- (45.8)	-153.8-	73.8
**SF12	29.3 (2.4)	29.1 (2.8)	0.2 (4.0)	-1.3-	1.7
**SEE	33.1 (14.5)	42.0 (21.7)	8.9 (27.9)	-1.6-	19.3
**FABQ – Physical Activity	11.2 (6.3)	15.9 (6.8)	4.7 (9.8)	-1.0-	8.3
**FABQ – Work	19.1(9.8)	29 (10.6)	9.9 (16.0)	-3.9-	15.9
**NRS	5.5(1.9)	7.6 (1.1)	2.1 (2.3)	1.7	3.2
**RMDQ	5.3(4.2)	2.3 (1.8)	-3- (4.5)	-1.3-	-4.7-

**** (IPAQ):** International Physical Activity Questionnaire; **(SF12):** A 12-Item Short-Form Health Survey; **(SEE):** Self-Efficacy for Exercise scale, **(FABQ):** Fear-Avoidance Beliefs Questionnaire; **(NRS):** Numeric Rating Scale **and (RMQ):** Roland–Morris Questionnaire.

NB: Results include the response from non-engaged participants to the intervention, please see section 5.5

Table 22: Proportion of LBP Participants undertaking Moderate and Vigorous Physical Activity per week (pre- and post-intervention)

LBP Group (N=30)

Days / week	Moderate Physical Activity		Vigorous Physical Activity	
	Pre-Intervention	Post-Intervention	Pre-Intervention	Post-Intervention
Not Started	4 (13)	3 (10%)	8 (27%)	7 (23%)
1 day	4 (13)	5 (17%)	4 (13)	10 (33)
2–3 Days	15 (50%)	12 (40%)	**17 (57%)	**3 (10%)
4–5 Days	*7 (23%)	*9 (30%)	1 (3.3%)	8 (27%)
Every Day	0	1 (3%)	0	2 (7%)

Note: Numbers are counts and percentages

**The proportion of participants meeting moderate physical activity recommendation based on the American Heart Association*

*** The proportion of participants meeting vigorous physical activity recommendation based on the American Heart Association*

5.4.1.2 12-Item Short-Form Health Survey (SF12)

As shown in Table 21, The results show no increase in quality of life after the WBI-BACK intervention programme for nurses with LBP. The mean change in SF12 scores was 0.2; however, a 95% confidence interval ranging from -1.3 to 1.7.

5.4.1.3 Self-Efficacy for Exercise scale (SEE)

Of the 30 participants with LBP who completed the pre-intervention SEE scales, the mean SEE was M= 33.1, SD =14.5 (Table 21). At post-intervention, the mean MES was M= 42.0, SD = 21.7. There was improvement in self-efficacy scores after the WBI-BACK intervention programme, the mean increase scores was 8.9; however, a 95% CI ranging from -1.6 to 19.3.

5.4.1.4 *Numeric Rating Scale (NRS)*

There was an increase in NRS scores post-web-based intervention, and the mean increase scores was 2.1, with a 95% CI ranging from 1.7 to 3.2. (Table 21). This indicated that the pain intensity level was increased in nurses with LBP after engagement in the WBI-BACK intervention programme.

5.4.1.5 *Fear-Avoidance Beliefs Questionnaire (FABQ)*

The FABQ consists of two subscales: fear-avoidance beliefs regarding PA and fear-avoidance beliefs regarding work. The results in Table 21 indicate an increase in fear-avoidance beliefs regarding both PA and work subscales from baseline to follow-up. These differences suggest that the participants' fear-avoidance beliefs about PA and work were increased after the WBI-BACK intervention programme, by the mean increase scores of 4.7 and 9.9, respectively.

5.4.1.6 *Roland-Morris Disability Questionnaire (RMDQ)*

The results from the preliminary analysis of the differences between RMDQ scores at baseline and post-intervention are presented in Table 21. There was a decrease in RMDQ scores, with a mean decrease score was -3, with a 95% CI ranging from -1.3 to -4.7. This result revealed that participants' physical functioning improved after engaging in the WBI-BACK intervention programme.

5.4.2 Results of Secondary Outcomes for NOLBP Group

The data from nurses without LBP were analysed using paired sample t-tests to determine whether the post-web-based intervention scores were significantly different from the baseline scores. Significance levels were specified at $p = 0.05$. Table 23 provides the results of the mean scores and standard deviations for the PA, quality of life and self-efficacy measures obtained from the preliminary analysis of NOLBP data.

Table 23: Outcome Measures for NOLBP Group

NOLBP Group (N=15)

Measures	Pre-Intervention Mean (SD)	Post-Intervention Mean (SD)	Differences in Mean Change at 95% CI (SD)	Mean Change 95 % CI)	
				Lower	Upper
**IPAQ –Total	341.1 (707.1)	579.1 (861.0)	238.1 (924.6)	-273.1-	750.1
**IPAQ – Vigorous	64.0 (247.9)	.0 (.0)	64.0 (274.9)	-73.3-	201.3
**IPAQ – Moderate	30.7 (85.1)	160.0 (431.9)	129.3 (413.1)	-99.9-	358.6
**IPAQ – Walking	246.4 (618.20)	419.1 (589.8)	172.7 (859.7)	-303.4-	648.8
**IPAQ – Sitting	24.0 (63.3)	12.7 (22.8)	-11.3- (67.7)	-48.8-	26.2
**SF12	28.5 (4.8)	27.3 (4.5)	-1.2- (4.7)	-2.7-	2.3
**SEE	38.7 (27.2)	39.6 (24.9)	0.9 (37.1)	-1.6-	1.0

***(IPAQ):** International Physical Activity Questionnaire; **(SF12):** A 12-Item Short-Form Health Survey and **(SEE):** Modified Self-Efficacy for Exercise scale.

NB: Results include the response from non-engaged participants to the intervention, please see section 5.5

5.4.2.1 *International Physical Activity Questionnaire (IPAQ)*

There was an increase in total PA and PA components (moderate and walking) after nurses' engagement in the WBI-BACK intervention programme, however, none of the participants engaged in the vigorous PA (Table 23). The mean of the post-intervention total PA MET min/week scores for nurses with NOLBP was (M= 579.1, SD = 861.0), higher than the baseline scores (M = 341.1, SD = 707.1). The mean increase scores for total PA was 238.1; however, a 95% CI ranging from -273.1 to 750.1. The mean increase scores for moderate PA was 129.3; however, a 95% CI ranging from -99.9 to 358.6.

5.4.2.1.1 *Moderate and Vigorous Physical Activity*

Moderate and vigorous physical activities were discussed earlier in this chapter. The proportion of participants who met the moderate PA recommendation was computed and summarised in Table 24 (below). From this data, the proportion of nurses with NOLBP who met the moderate PA recommendation decreased after the WBI-BACK intervention programme to 1 (7 %), in comparison to the baseline of 3 (20%), whereas there was an increase in the number meeting vigorous PA, from 3 (20%) to 5 (33 %).

Table 24: Proportion of NOLBP Participants doing Moderate and Vigorous Physical Activities per week

NOLBP Group (N=15)

Days / week	Moderate Physical Activity		Vigorous Physical Activity	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Not Started	3 (20%)	6 (40%)	8 (53)	6 (40%)
1 day	2 (13%)	1 (7%)	2 (13%)	2 (13%)
2–3 Days	6 (40%)	4 (27%)	**3 (20%)	**5 (33%)
4–5 Days	*3 (20%)	1 (7%)	1 (3%)	0
Every Day	1 (7%)	3 (20%)	1 (3%)	2 (13%)

Note: Numbers are counts and percentages

**The proportion of participants meeting moderate physical activity recommendation based on the American Heart Association*

*** The proportion of participants meeting vigorous physical activity recommendation based on the American Heart Association*

5.4.2.2 12-Item Short-Form Health Survey (SF12)

The results from Table 23 show a minimal decrease in SF12 Health scores with a mean reduction score of -1.2; however, a 95% CI ranged from -2.7 to 2.3.

5.4.2.3 Self-Efficacy for Exercise scale (SEE)

Of the 15 nurses with NOLBP who completed the baseline and post-intervention measures of SEE, the results indicate a slight change in self-efficacy after the WBI-BACK intervention programme. The mean increase score was 0.9; however, a 95% CI ranging from -1.6 to 1.0 (Table 23).

5.5 Results from Non-Engagement Participants

Previous literature has differentiated between attrition rate from the study (i.e., loss to follow up or drop out from the study) and non-engagement from the digital intervention, which has an impact on the effectiveness of the digital intervention (Alkhaldi et al., 2016). While the total attrition rate was reasonable in this study (15%, 9% in the LBP group, and 6% in the NOLBP group); there were 5 participants (2 (7%) in the LBP group and 3 (20 %) in the NOLBP group) did not engage in the web-based intervention programme. However, they agreed to participate in the study and completed pre- and post-intervention outcome-measure questionnaires. Previous primary and secondary quantitative results have some data that may be random as they did not have access to the WBI-BACK intervention programme, and therefore their clinical and behavioral outcome measures did not change, which may affect the results. A more understanding of participants engagement realize that the engagement is a process and produce of people's interactions with digital intervention which affect their behavioural, emotional and cognitive measures (Torous, Michalak, and O'Brien, 2020).

Notably, four out of the five non-engagement participants negatively expressed their usability, usefulness and attitude toward the WBI-BACK intervention programme (see Table 18, 19, 20). When we compared with other engagement users, we found a negatively behavioural pattern based on TAM questionnaires, such as usability of the WBI-BACK intervention, increasing their knowledge and self-confidence in managing LBP and improving their job performance. Other notable findings from the secondary outcome measures increased the intensity of LBP and fear avoidance belief after engagement with the WBI-BACK intervention (Table 22). Clinically, interpreting these simple results becomes complex. This variation in the results can be attributed to the extent to which the non-engagement participants in the LBP group report this issue. These results remind us that the influence of non-engagement participants' results needs a complete understanding of the effectiveness of outcome measures after a web-based

intervention. Therefore, it is suggestive that future studies should examine ongoing engagement with the digital intervention that is related to the effectiveness of outcome measures and understand any confounding variables associated with outcome measures.

5.6 Chapter Summary

This is the first study to assess the feasibility and acceptability of the WBI-BACK intervention programme for self-management of LBP for nurses working in the KSA. This chapter explored the quantitative feasibility outcome measures and the sensitivity in detecting change in LBP outcome measures after the WBI-BACK intervention programme, to measure the effects of these measures and inform future trials. The primary feasibility measures include recruitment rate, attrition rate, intervention engagement and experience of the intervention. The secondary measures were PA, quality of life, self-efficacy, fear avoidance belief, pain intensity and physical functioning for nurses with LBP, as well as PA, quality of life and self-efficacy for those without LBP. Intervention effects for the secondary outcome measures were presented as means, SD, and CI of the mean. There was an improvement in outcome measures in both groups after engagement in the WBI-BACK intervention. However, the results should interpret with cautions as the current feasibility study is not powered to detect changes after the intervention. Additionally, non-engagement participants' responses could affect the study's result. These results will be assessed against a priori feasibility criteria in Chapter 7 and discussed in detail in Chapter 8. The next chapter presents the qualitative results

Chapter 6: Qualitative results

6.1 Introduction

The previous chapter in this thesis presented the quantitative results that supported the feasibility of the WBI-BACK intervention programme in regard to PA, quality of life, self-efficacy, fear avoidance belief, pain intensity and physical functioning. The qualitative data in this chapter was reported according to the Standards for Reporting Qualitative Research (SRQR; (O'Brien et al., 2014). This chapter will present the qualitative findings from semi-structured interviews including the interviewee characteristics of participants. Consequently, themes and subthemes are defined. This is followed by a summary of the qualitative findings.

6.2 Study Aim and Objectives

The aim of the qualitative study is to investigate the attitudes and experiences of participants (nurses with and without LBP) regarding the use of the WBI-BACK intervention programme for self-management of LBP. The specific objectives:

- To acquire more understanding from nurses' thoughts, experience and feedback regarding the use of the WBI-BACK intervention programme.
- To explore the nurses' behavioural interactions with the WBI-BACK intervention programme by investigating the acceptability, engagement, and usability of the programme in the self- management of LBP.
- To explore the barriers preventing the use of the WBI-BACK intervention programme and suggestions for improvement.

6.3 Study Design

A purposive sampling approach was carried out in this study to generate a greater depth of understanding of the research phenomena and afford a rich source of data (Creswell and Plano Clark, 2011; Sandelowski, 1995) . Therefore, a purposive sampling of 18 participants was targeted for recruitment. This sample size was selected based on the previous literature, in that the sample size for a qualitative approach to feasibility studies is usually small, and ranges between five and twenty participants (O’Cathain et al., 2015). Semi-structured interviews were conducted with participants after the post-intervention quantitative measures. The interviews were conducted by a PR and carried out face-to-face in KFMC’s Rehabilitation Hospital in the KSA. All study participants (nurses in both LBP and NOLBP groups) were eligible to participate in the interviews, and there were no exclusion criteria stated to prevent participation. The interviews lasted approximately 20-30 minutes and were audiotaped with regard to confidentiality (See section 4.6 for more details).

6.4 Interviewee Characteristics

Qualitative semi-structured interviews were conducted with 16 nurses. The interviewees were drawn from the participants who had (LBP) (N=35) and those without a history of LBP (N=15). More than half of the participants were female (11/16). Their mean age was 32, while the mean age of male was 29. The demographic details of the participants including the gender, age, occupation duration of service and their hospital-work department are presented in Table 25. All participants’ names have been altered to pseudonyms.

Table 25: Characteristics of Interviewees

Participant ID	Age	Sex	Nationality	LBP	Current Position	Years of Service	Working Department
Interviewee 1	27	F	Filipino	Yes	Registered nurse	4 years	Ward 3- Neurorehab and Stroke inpatient rehabilitation
Interviewee 2	30	F	Filipino	Yes	Registered nurse	5 years	Ward 3- Neurorehab and Stroke inpatient rehabilitation
Interviewee 3	27	F	Filipino	Yes	Registered nurse	4 years	Ward 2- neuro stroke inpatient rehabilitation
Interviewee 4	36	F	Indian	Yes	Registered nurse	13 years	Ward 3- Neurorehab and Stroke inpatient rehabilitation
Interviewee 5	27	M	Saudi	No	Registered nurse	9 months	Ward 2- neuro stroke inpatient rehabilitation
Interviewee 6	31	M	Saudi	No	Registered nurse	6 years	Ward-4-Inpatient rehabilitation- Traumatic brain injury
Interviewee 7	30	F	Filipino	No	Registered nurse	8 years	OPD Rehabilitation
Interviewee 8	49	F	Filipino	Yes	Head nurse	26 years	OPD Rehabilitation
Interviewee 9	31	F	Filipino	Yes	Registered nurse	9 years	OPD Rehabilitation
Interviewee 10	28	M	Saudi	No	Registered nurse	6 years	Ward-4- Inpatient rehabilitation -Traumatic brain injury
Interviewee 11	33	F	Filipino	Yes	Nursing supervisors (Administration)	12 years	Rehabilitation Hospital
Interviewee 12	34	F	Filipino	Yes	Registered nurse	10 years	Ward 3- Neurorehab and Stroke inpatient rehabilitation
Interviewee 13	29	F	Filipino	Yes	Registered nurse	5 years	Ward 3- Neurorehab and Stroke inpatient rehabilitation
Interviewee 14	23	M	Saudi	YES	Intern	2 months	Ward 4- Traumatic Brain Injury
Interviewee 15	35	M	Jordan	Yes	Unit Manager	20 years	Ward-1- Spinal Cord inpatient rehabilitation
Interviewee 16	23	F	Saudi	Yes	Intern	2 months	Ward 4- Traumatic Brain Injury

4.5 6.5 Data Analysis

Thematic analysis (Braun and Clarke, 2006) was used to analyse the data by a combination of both inductive (mainly derived from data) and deductive (mainly derived from theory) analysis, which have been demonstrated previously in Chapter 4, section 4.6.4. All participants' interviews were recorded and transcribed for analysis. Each transcript was repetitively read by a PR and a specialist in qualitative research in order to identify the themes. Then, developing themes and codes were discussed by the main supervisors to refine the analysis. Thus, it was expected that the findings would result in three themes (usability, usefulness and engagement), deductively based on the TAM theoretical concept related to the acceptance of the WBI-BACK intervention programme. This was in addition to other associated theme that inductively analysed and related to the feasibility of the WBI-BACK intervention programme.

6.6 Tabulation of the Themes, Subthemes and Codes

A total of four themes were generated from 9 subthemes which applied to the data. The themes and subthemes outline the main feasibility issues of the WBI-BACK intervention programme in order to inform its use in future studies with nurses. The explanations and descriptions of the themes, subthemes and codes are supported by verbatim quotes from interview participants. All quotes are anonymised and referenced by the participant's ID number. The key findings are summarised in Table 26.

Table 26: Outline of Themes, Subthemes and Codes from Semi-structured Interviews

Themes	Sub-Themes	Codes
1- Nurses' perception of usability of the WBI-BACK intervention programme	• Usability of WBI-BACK content • Usability of WBI-BACK technical characteristics	• Simple format of the WBI-BACK content • Images and videos selection • Navigation the WBI-BACK
2- Nurses' perceptions of potential WBI-BACK usefulness	• Enhanced Knowledge • Increased PA	• Increased knowledge for self-management of LBP strategy • Decrease in LBP symptoms • Types of PA
3- Nurses' engagement with the WBI-BACK intervention programme	• Module accessed in the WBI-BACK • Facilitators for WBI-BACK engagement • Barriers to WBI-BACK engagement • Suggestions for improvement of the WBI-BACK • Recommendation of the WBI-BACK to others	• Job-related factors • Technical factors • The characteristics of the WBI-BACK
4- Nurses' attitudes towards the WBI-BACK intervention programme	-	-

6.6.1 Theme 1: Nurses' Perceptions of the Usability of WBI-BACK

Intervention Programme

This section will display evidence indicating that the WBI-BACK intervention programme was easy to use for nurses with and without history of LBP. Importantly, the usability of WBI-BACK intervention programme content and technical characteristic subthemes were identified. The subthemes bring together the concepts of the simple format of WBI-BACK content, images and videos selection and navigation of the WBI-BACK intervention programme. The definition of usability in this study is defined earlier in the chapter 3 (see section 3.3.2).

6.6.1.1 Usability of WBI-BACK content

Innovative digital interventions are easier to use when designed to reduce ambiguity and complexity and increase involvement. This issue has a direct effect motivation to use, and ultimately, actual use of the WBI-BACK intervention programme. The following subthemes will provide data indicating to what degree the material of the WBI-BACK intervention programme is easy to use.

6.6.1.1.1 Simple format of the WBI-BACK content

Overall, nurses reported simplicity with regard to the modules that were used in the WBI-BACK intervention programme. They thought the modules were well designed, useful and easy to use. Interviewee 12 expressed her view toward the ease of use of the WBI-BACK programme:

“It was easy for me to use, and it was really very informative and it’s easy because you just have to scroll it.” (Interviewee 12)

Similarly, Interviewee 7 expressed her feelings about the ease of the WBI-BACK programme:

“Yes, because it’s just one click on the Internet then click and click and click. You can see what do you want to know and answer your questions regarding the low back pain.”

(Interviewee 7)

The simple format of the WBI-BACK intervention programme in delivering intervention for LBP for nurses was generally considered as conducive to engagement with this intervention. Most of the nurses reported the ease of use and acceptability of this intervention programme. They explained how the calm background colours, interesting format and content motivated them to use the WBI-BACK intervention programme. In this regard, Interviewee 6 expressed how he felt about the content of WBI-BACK programme:

“Yes, it is easy and ... you can understand them [WBI-BACK contents] because there is colour and I understand in the programme. Yes, you can understand because there is colour and there is a specific something if you want to go inside. You can go, and it’s easy for work.”

(Interviewee 6)

The diversity of presentations in the modules added interest to the content. Some of the nurses felt that the WBI-BACK intervention programme was accessible and enjoyable. The information and content were reported to be easy to understand and interact with. Interviewee 8 identified the layout of the program as part of the reason for its ease of use:

“The words that you used is easily understandable, no need to ask someone to explain, it’s self-explanatory.” (Interviewee 8)

On the other hand, two participants found difficulty in using the WBI-BACK intervention program and suggested instructor-led programs, whereby nurses are guided in the process of using the programme. Although the modules are interactive, the presence of an instructor was suggested to enhance usability. According to Interviewees 12 and 5:

“The best way to deliver this program to the nurses is that you can provide an education.”

(Interviewee 12)

“To improve that, you need to explain for all the ... the information before.” (Interviewee 5)

This is specifically in terms of the knowledge in the programme about how to perform the PA and exercises correctly, and ultimately, how to use the WBI-BACK intervention programme effectively. The suggestions for improvement are premised on the need to increase perceived ease of use. Resolving some of these challenges might require simplifying the content in each of the modules, and also the presence of an instructor would further enhance usability.

6.6.1.2 Usability of the WBI-BACK technical characteristics

It has been reported that technological support is essential for delivering any digital intervention, and this would include enhancement of the usability of the WBI-BACK intervention programme. The WBI-BACK intervention programme has thus been developed in a basic style featuring including clear words, pictures, videos and interactive components, and facilitated easy transfer from one module to another. The following sections will provide data regarding the technical characteristics of the WBI-BACK intervention programme.

6.6.1.2.1 Image and Video Selection

The interactive images and videos in the WBI-BACK intervention programme make it easier for the participants to understand the content. For instance, Interviewee 9 expressed this opinion about the digital intervention:

“It’s very useful and very good to have an example because mostly, it’s good because it has a picture so even though you cannot understand the dialogue but surely, you can understand it well because there’s a word and there’s a picture so you can properly understand.” (Interviewee 9)

Understanding the contents of the WBI-BACK intervention programme is strongly related to the visual aids such as pictures, and participants claimed to find it easy to understand whilst having the visual aids. For example, Interviewee 14 emphasised the clarity and the usefulness of the images and videos:

“It’s useful, very useful.” (Interviewee 14)

In this study, nurses felt that the WBI-BACK intervention programme was developed and provided using a design that was easy to use in helping them manage and prevent their back pain, which is one of the primary goals of this digital intervention programme. Importantly, the images and videos in the WBI-BACK intervention programme served as a reminder to promote doing the exercises. In the case of Interviewees 5 and 6, they always accessed the videos in the WBI-BACK intervention programme to perform the exercises:

“I have access to the video always.” (Interviewee 5)

“I think this one, the 3D, I think. The video. I think it's... is clear and I use it for some exercising.” (Interviewee 6)

Interviewee 16 highlights how the images and videos helped her to perform the exercises:

“The image was clear. The way in the image on how to do the exercise is very clear to me. (Interviewee 16)”

Issues of confidence and perceived ease of use for the WBI-BACK intervention programme were reported by all participants regardless of the nurses’ experience and knowledge. Despite this, nurses expressed positive sentiments toward the design of the technology used in the WBI-

BACK intervention programme, and only two of them faced technical difficulties in downloading images and videos. For instance, Interviewees 14 and 15 stated:

“Just technical issue for that.” (Interviewee 14)

“There some pages just lagging and it’s maybe from my computer... My internet is very fast but it takes time to open.” (Interviewee 15)

6.6.1.2.2 Navigation of the WBI-BACK Programme

The multimedia feature in the WBI-BACK intervention programme was one aspect that facilitated navigation from one module to another. There was an acknowledgment from the nurses that the WBI-BACK intervention programme utilised simple transitions from one module to another. Most of the nurses felt that the transition between modules was very easy to navigate. Interviewees 6 and 13 reported the ease of transition from one module to another:

“If you are finish with one module you just click the next and it’s accessible.” (Interviewee 6)

“No, it's not really difficult, because it has criteria or categories where you can click. For example, I have to click on the exercise module or this module or if I started with the first module, you can just click one, two, three, four and so on, until you pass all the modules.” (Interviewee 13)

In contrast, some participants found difficulties in using the navigation due to lack of Internet connection. Interviewee 2 faced difficulty in moving from one module to another due to poor network reliability:

“Sometimes internet connection is not good like that, so if you want to move to another module, it’s hard.” (Interviewee 2)

Concerns around poor Internet connectivity of mobile devices and computers was a barrier to accessing the WBI-BACK intervention programme, and this will be discussed later in this chapter.

6.6.2 Theme 2: Nurses’ Perceptions on Potential WBI-BACK Intervention Programme Usefulness

Potential for improvement is premised on the need to increase perceived usefulness and eliminate adverse external factors. The nursing participants in this study were asked to reflect on any impact or changes that they had noticed since completing the intervention. They reported a broad range of benefits, including increased knowledge about LBP self-management, specifically regarding prevention and reduction of LBP, and increased participation in exercises and PA. Therefore, this theme involves the sub-themes that are related to the specific aspects of the WBI-BACK intervention programme that were valued by nursing participants among both the LBP and NOLBP groups in terms of enhancing their knowledge, increasing their physical activity which could decrease LBP symptoms.

6.6.2.1 Enhanced Knowledge

The WBI-BACK intervention programme is designed in a manner that includes information to help nurses to gain new knowledge for the management and prevention of LBP. The knowledge gained plays an integral role in the way they utilise the WBI-BACK intervention programme, as well as their understanding of how to manage LBP. This subtheme comprises enhanced knowledge for the self-management of LBP and decrease in LBP symptoms.

6.6.2.1.1 Increasing Knowledge for Self-Management of LBP Strategy

Gaining new knowledge could help the nurses to better manage their LBP, work for longer hours, apply good lifting and handling techniques when lifting patients and enable them to do more in the workplace. Most nursing participants were positive about the knowledge in the WBI-BACK programme related to self-management of LBP. The participants identified that gaining knowledge was one of the key benefits of the WBI-BACK intervention programme. In this section, quotes relating to awareness of the usefulness of the WBI-BACK intervention programme in influencing self-management of LBP are mentioned. The nursing participants referenced the fact that the modules accessed provided information and guidance. According to Interviewee 1, female nurses with LBP, expressed a view about the knowledge for self-management of LBP in the WBI-BACK intervention programme:

“There’s a lot of education there written, and it is very appropriate for me to use...”

(Interviewee 1)

As a result, the WBI-BACK intervention programme helped nurses to take care and self-manage their back pain. The participants highlighted that acquisition of knowledge about prevention and interventions for LBP encouraged them to adopt a more active lifestyle. The link between knowing what to do and engaging in exercises to reduce or prevent LBP is apparent from the biopsychosocial approaches for the self-management of LBP, as indicated by the contents of the six modules. Interviewee 9 expressed this opinion:

“The programme gives me a lot of knowledge how to manage and to intervention my lower back pain and it’s give you the guidelines so that you are preventing the severance of your lower back pain.” **(Interviewee 9)**

Importantly, the information in the educational, exercise, and PA modules in the WBI-BACK intervention programme offered suggestions and recommendations to change the participants' behaviour and on how to do the exercises. Thus, the participants indicated that they had learnt how and why to exercise from the programme. Interviewee 9 expressed the usefulness of the WBI-BACK intervention programme through her willingness to do exercises as a part of her daily routine:

“The most important knowledge I gained is my exercise, how to make you relieve back pain and the maintenance to make everyday day as usual as you can.” (Interviewee 9)

In addition to offering information about LBP self-management, the WBI-BACK intervention programme offered suggestions on exercises. As a result, nurses developed self-confidence in their ability to do exercises for LBP. Interviewees 12 learned how and why to do exercises from the WBI-BACK intervention programme:

“When you approach me, I had pain on my back on and off around if I will score it's around five to six and it is being relieved with the corset that's I'm wearing, but if you'll notice I'm not wearing it any more right now. I stopped using the corset and I continued doing the exercise.” (Interviewee 12)

As a result of these concerns, the WBI-BACK intervention programme reminded nurses of the necessity of self-management of LBP. The quality and the contents of the WBI-BACK intervention programme helped them to think about LBP self-management. In support, Interviewee 12 stated:

“It is reminding me... if the pain is occurring... I have to be careful utilising my back always.” (Interviewee 12)

Interviewee 13 agreed with this opinion, and indicated that this helped to influence her decision to take better care of her back:

“I’m more conscious now. I have to think about my back, because this mild back pain can lead to more severe or chronic pain if I’m not conscious.” (Interviewee 13)

The information from the intervention programme also helped some nurses to make decisions that could help them to reduce their LBP, such as manual handling and correct lifting techniques. They learned how to maintain the correct posture when lifting and transferring patients. Interviewees 10 and 4 has a clearer appreciation of learning about ergonomics when working, such as lifting and handling techniques:

“For example, how to move the patient from the bed to wheelchair, how to use my leg and my thigh than my back.” (Interviewee 10)

“Putting the feet wide apart and standing straight whenever you handle with any items, do not use the thigh muscle...” (Interviewee 4)

Interviewee 13 explained how to apply good body biomechanics in lifting:

“... I have to use the proper alignment also of the body. If I have to pick up stuff on the floor, I just have to instead stretching my knee, I just have to... fold up...”

For nurses with no history of LBP, the WBI-BACK intervention programme is also useful, providing prevention strategies related to LBP. Interviewee 10 commented on the programme:

“They give more prevention how to combat my back pain. This is my point. I get more prevention, more information how to save my back.”

6.6.2.1.2 Decrease in LBP Symptoms

Among the LBP group, decrease in LBP symptoms represents a primary objective of the intervention programme. The reduction in LBP symptoms can be attributed to several secondary reasons, which explains the variations in the extent to which the participants reported this benefit. The extent to which they reported a reduction in LBP is dependent on the quality and quantity of knowledge gained about the preventions and interventions of LBP from the programme. Participants stated that the knowledge they acquired from using the programme helped them to understand the causes and interventions for LBP. Some of the nurses in the LBP group reported a reduction in LBP symptoms after using the WBI-BACK intervention programme. The reduction in LBP for nurses was attributed to gaining knowledge about prevention and interventions for LBP. In the case of Interviewee 16, who explained her pain feeling after using the WBI-BACK intervention programme:

“Actually, I feel my pain is decreased after about two weeks. I have more energy, more strength to do an activity better than before.” (Interviewee 16)

Similarly, Interviewee 2 experienced a reduction in LBP symptoms, primarily due to better self-management:

“That's why I said a while ago, it helps me a lot to lessen my low back pain because of the management that the web-based programme put in the modules like that the module does a lot to do and management that easily to adapt also and do. That's why it helped me a lot.” (Interviewee 2)

Participants also reported a reduction in LPB symptoms due to increased knowledge about the causes of LBP from the contents of the WBI-BACK intervention programme. Participants learned that LBP is caused by occupational hazards such as long hours at work, lifting patients

and lack of enough rest among others. Awareness about these cause-and-effect relationships led to changes in the behaviour of the participants. Interviewee 4 told a PR how she felt after following the handling techniques in the WBI-BACK intervention programme:

“I follow the instructions what I have to do when I'm handling my patients... Now I feel slightly reduced.” (Interviewee 4)

Some participants highlighted that the information and knowledge gained from the WBI-BACK programme was useful for them in reducing LBP symptoms. In part, this was due to increased awareness of the benefits of doing exercises for self-management of LBP. Interviewee 1 reported that her back pain had decreased when bending:

“The last time when I bend, I feel pain here at my back and when using that exercise in the educational gallery, it lessened, unlike before.” (Interviewee 1)

Overall, most of the nursing participants expressed the usefulness of the WBI-BACK intervention programme, and that they gained knowledge about how to cope with their back pain and learn self-management strategies. It would appear that the WBI-BACK programme is informative and useful for nursing participants with and without a history of LBP in preventing and managing their back pain.

6.6.2.2 Increased Physical Activity

Some of the nursing participants tended to increase their PA level after engagement with the WBI-BACK intervention programme. The intervention programme encouraged them to engage in more physical activities. The increase in PA can be traced to the fact that they acquired information on which exercises to engage in without aggravating the problem, based on the qualitative data. Importantly, engaging in the WBI-BACK intervention programme

helped two of the nursing participants to increase their PA and to access the gym. For instance: Interviewees 6 and 14 clearly stated that:

“When you send the email, I remember to do the exercise, walking, jogging, and I just go to the gym.” (Interviewee 6)

“I’m going to gym after seeing the website.” (Interviewee 14)

Similarly, Interviewee 9 expressed that the WBI-BACK intervention programme had improved her PA levels, which helped her with management of LBP symptoms:

“It increased mostly 80% of my exercise level... it’s very helpful.”

The WBI-BACK intervention programme includes PA elements which could encourage nurses to add exercise activities to their daily routines to prevent or manage their back pain. In the same way, some of the nursing participants noted that they learned how many minutes of exercise adults should do per week based on the PA guidelines. Interviewee 11 expressed a view about the total amount of exercise in a week:

“It depends also on the exercise, the amount of exercise that I do and there should be at least 150 minutes in a week.” (Interviewee 11)

However, 10 participants did not perform any PA exercises, and as a result there was no change in their PA levels or their records in the diary of PA sheet. The main barrier was not a fear of doing exercises, but could be a lack of knowledge and skills in relation to PA which significantly affected the usefulness of the WBI-BACK intervention programme. In support of this interpretation, Interviewees 9 and 7 expressed their feelings when asked, ‘Does the WBI-BACK programme help you to increase your physical activity level?’:

“Yes, mostly, I make average at 99%. It is good because it helps me to move easily and how the proper way.” (Interviewee 9)

“I think no [change in physical activity level]. Because I am active person. I’m active person. I’m doing a lot of walking... I read that walking is not included in physical activity.” (Interviewee 7)

A lack of knowledge regarding PA significantly affected the WBI-BACK intervention programme’s usability in terms of increasing physical activity levels and setting a weekly plan. In particular, some participants appeared to lack an understanding of the key concepts of PA and exercises. Interviewee 2 valued the benefit of the WBI-BACK intervention programme for increasing PA levels:

“Yes, my tolerance now is better than before.” (Interviewee 2)

The challenges associated with a lack of time were identified as another barrier to increasing PA levels for the nurses. The participants indicated that they were unable to consistently utilise all the contents of the WBI-BACK programme, and were therefore unable to gradually build upon new knowledge associated with increasing their PA levels and maintaining records of PA.

6.6.2.2.1 Types of Physical Activity

Walking was the most common PA practiced among LBP participants, and engagement in walking activities was reported from many nurses after engaging in the WBI-BACK intervention programme. The viability of walking can be attributed to the ease with which the exercise can be carried out, as well as the fact that most of the nursing staff have to walk as

part of their daily schedule. According to Interviewees 4 and 7, walking can be performed at work whilst doing normal duties:

“All the work what we are doing here in the ward.” (Interviewee 4)

“Because I’m active person. I’m doing a lot of walking, of course, nursing.” (Interviewee 7)

Interviewee 1 indicated that she prefers walking as a means to decrease her LBP:

“...when I walk lesser pain now unlike before, because I don’t do running, only walking.” (Interviewee 1)

Some nursing participants reported improvements in walking distance after engagement in the WBI-BACK intervention programme, and this typically was associated with a change in lifestyle:

“Before when I come to my office, I like to sit in my chair and use my computer. Now I am trying all the time to be standing and walking...” (Interviewee 10)

He reported that his walking distance increased to ***“more than two hours”***, whereas his walking distance before was ***“not more than 15 minutes.”***

Given that nurses spend most of their time walking as a requirement of their job, increased awareness of walking benefits could influence their walking distance. Interviewee 11 reported an increase in walking distance after taking part in the WBI-BACK intervention programme:

“Before brisk walking, I don’t do maybe two minutes a day like that when I need to go to other departments, I do brisk walking and normal walking. Now, when I go to other

departments, I usually go for another round, and then I do brisk walking for at least 20 minutes.” (Interviewee 11)

There were a small group of nurses who performed a variety of other exercises such as biking and jogging, for whom the WBI-BACK intervention programme would be of greater help. Interviewee 9 stated that she did biking and jogging:

“I make the biking... making jogging.” (Interviewee 9)

In summary, the usefulness of the WBI-BACK intervention programme for nursing included increasing knowledge about LBP and exercising, reducing LBP symptoms and increasing PA levels. Most of the nursing participants in this study were positive about the WBI-BACK programme in terms of an increase in knowledge around the benefits of exercise and PA in the management of LBP.

6.6.3 Theme 3: Nurses’ engagement with the WBI-BACK intervention programme

In this study, engagement is defined as a nurse’s experience of and interaction with the WBI-BACK intervention programme. This section will illustrate some evidence from nurses that reflects their engagement with the WBI-BACK intervention programme such as the modules accessed in the WBI-BACK, facilitators to the WBI-BACK intervention programme, suggestions for improvement the WBI-BACK intervention programme and recommending the WBI-BACK intervention programme to others. However, there were some barriers that impacted the usability of the digital intervention and stopped participants navigating the WBI-BACK programme easily.

6.6.3.1 Module Accessed in the WBI-BACK Intervention Programme

The extent to which the interviewees accessed the programme varies from one individual to another and can be explained by the extent to which they perceived the programme as being useful, and also as to whether they had the time and resources to access the WBI-BACK intervention programme. These variables explain why some participants accessed the programme with a higher frequency than others.

The WBI-BACK intervention programme is comprised of six modules (see Chapter 3, section 3.6), that the participants can access, even though not all modules were accessible to the participants. Interviews with nurses indicated that the participants accessed multiple modules under the WBI-BACK intervention programme differently, with varying degrees of frequency. The most preferred modules were the educational, exercise and PA modules, because they offered a broad range of information about the self-management of LBP. Interviewee 14 expressed his feeling toward the engagement in the WBI-BACK intervention programme:

“Education first. After that I begin to watch exercise and spend much time for these physical activities.” (Interviewee 14)

Since the educational module is the first in the WBI-BACK intervention programme, it was common for most of the participants to start with it after logging into the programme. Based on its design, the educational module offers general information and knowledge about LBP such as preventive and management strategies for LBP. Participants also perceived it as being useful because it offers information relevant to other modules:

“From the education that was provided of course the body mechanics and everything.” (Interviewee 12)

Thematic analysis of the interviewees revealed that the exercise module was also one of the most popular modules that was accessed by most of the participants. The preference for the exercise module arises from the fact that nurses were motivated to know how to perform the exercises that could help them to decrease and prevent their back pain. Most of the nursing participants showed their engagement by observing the videos and images that demonstrated the exercises for LBP, reading the articles and answering the interactive activities. Interviewee 16 in the LBP group went to the educational as well as exercise modules, and explored the information about self-management of LBP:

“I go to the educational module at the beginning to have some background about the programme itself. Then I go through the exercises. The strengthening. I saw some strengthening exercise, stability exercise.” (Interviewee 16)

Yet despite this, there were noticeable differences in the level of engagement with the exercises module between participants in the LBP and non-LBP groups. Given that the participants in the NOLBP group stood to benefit through knowledge of how to prevent LBP, they did not display a similar level of enthusiasm towards accessing the program as the LBP group. Interviewee 7, who had no history of LBP expressed her views toward the engagement in the WBI-BACK intervention programme:

“Because right now I didn’t experience back pain. When I experienced I will do it on my own. I know how to do the proper exercise in the LBP. I have stock knowledge. If ever experience LBP I know how to manage that one using exercise.” (Interviewee 7)

In other cases, participants indicated that they lack sufficient time to fully access the contents of the entire programme in one sitting, and in most cases, they were not able to fully access any single module in one sitting. The lack of sufficient time is evident from the fact that

participants reported that they were able to access all modules during the study period. As a result, the participants did not fully internalise and appreciate the contents of the modules as intended:

“It will take time because nurses are not used to this kind of programme. We’re just managing our own back pain, even though it’s not only back pain, like headache, like stress, we’re used to manage on our own. We’re the one who’s coping with our problem that’s why, it will take time about programme.” (Interviewee 7)

Similarly, due to the lack of time, the participants were unable to consistently utilise the WBI-BACK intervention programme, and therefore, unable to gradually build upon progress in the knowledge and activities associated with other modules such as the psychological and healthy lifestyles modules. Interviewees 16 and 12 stated:

“I go to the educational module at the beginning... Then I go through exercises. The new thing for me is the physical activity... This module I go through is the last.” (Interviewee 16)

“Educational gallery yes and of course the exercise gallery and physical activity.” (Interviewee 12)

Importantly, the result from the thematic analysis reveals that there was a lack of effort to record progress in the access and use of the WBI-BACK intervention programme, to ensure progressive learning and use. In some instances, the decision and ability to progress to subsequent modules are determined by the extent to which the content in the subsequent modules is found interesting and enjoyable. The interplay between insufficient time and accessing all modules in the WBI-BACK intervention was considered a barrier facing the participants. The outcome in perceived actual benefits from accessing multiple modules was

lessened, possibly because the participants did not internalise the contents in those modules due to rushing through the content:

“It depends. If I get time, I will continue with that, or else I may skip one module and then I will go....” (Interviewee 4)

It became clear from the qualitative data analysis that the level of engagement with the WBI-BACK intervention programme varied between participants. Furthermore, the analysis of the interviews indicated that a high number of participants engaged with the WBI-BACK modules and looked at the contents but did not necessarily change their behaviours. In particular, the benefits of the WBI-BACK appear to vary depending on engagement, awareness of LBP and levels of self-management. Interviewee 12, who engaged with the educational, exercise and PA modules, and managed to practice self-management with LBP stated:

“When you... approach me I had a pain on my back on and off around if I will score it’s around five to six and it is being relieved with the corset that I’m wearing, but if you’ll notice I am not wearing it any anymore right now. I stopped using the coreset and I continue doing the exercise.” (Interviewee 12)

The degree of engagement and level of motivation are important indicators of uptake of the digital intervention (Hardiker and Grant, 2011). This includes a genuine interest in one's own health, an openness to new experiences, and the conviction that knowledge may make a difference in one's overall well-being (Hardiker and Grant, 2011). The following is what Interviewee 8 had to say:

“I think more awareness for the staff on how good this programme is, how beneficial this is for them because if you really want to manage your back pain, then you will do it. You will not say you are busy. You will really allot a time. You will separate a time.” (Interviewee 8)

In-depth interviews with nurses who had LBP revealed the interplay between motivation and engagement, both of which were supported by automated responses generated by the WBI-BACK module. This also helped the nurses in interpretation and management of their back pain. Interviewee 1 reflected on how the desire and motivation to decrease LBP symptoms and perform exercises helped nurses to engage in the WBI-BACK intervention programme and explore all the modules:

“For me, I think you can access the WBI-BACK programme if you really want it or if you really, really like to finish it all the programme.” (Interviewee 1)

Also, the nursing participants reported that a willingness to find out how to manage their LBP helped them to engage in the WBI-BACK programme. Interviewee 16 highlighted that nurses should have time to do exercises and take care of their backs, even though they have a busy schedule and time challenges:

“Actually we have to convince ourselves in the beginning of the programme that we can find time to... if we said 30 minutes we can sometimes do it not in the same time, in the same session. Sometimes I can do it 15 minutes in my first break and 15 minutes in another break. For me this is a good thing. I can access it at any time.” (Interviewee 16)

Likewise, Interviewee 8 had a similar view:

“Maybe you need discipline. If you really need to have an exercise, you have to set time and make your time free for exercise in order to improve and in a way, it’s for our own good.”

(Interviewee 8)

Finally, Individuals' adherence to exercise is an important issue, and the reasons for this are varied, encompassing both psychological and situational factors (Hardiker and Grant, 2011). Self-compliance motivates the users to engage with the programme, and in particular to adhere to the exercises. Interviewee 7, who suggested to engage to the digital intervention twice only for 10 minutes stated:

“I’m so lazy to do any kind exercise that’s why the barrier is the compliance because I’m lazy. Work, you’re stressed, you’re tired, when you got home you just like sitting and lying, that’s all. That’s why when I read this one LBP, I know to execute that one at home like this one. Just simple, but the compliance is really hard to sustain.” (Interviewee 7)

6.6.3.2 Facilitators for WBI-BACK Programme Engagement

One of the facilitators for the delivery of the WBI-BACK intervention was the flexibility and acceptability of accessing the WBI-BACK programme. Considering the work schedule and time constraints for the nurses, the delivery of digital interventions to enhance self-management of LBP is an important factor. The flexibility of accessing the WBI-BACK intervention programme increases the benefit of the digital intervention among a nursing population. It makes it easier for them to access the modules even when they have limited time, day or night. They can also access it at work or at home, depending on their availability. Interviewee 16 expressed her feelings about the digital intervention:

“Actually, the good thing in this programme is home-based exercise. I can do it at home. I can do it during my work if I have free time. During my breaks. I can go through it any time...” (Interviewee 16)

Among those who accessed the programme at home, their decision was based on the fact that they did not have sufficient time at work. Interviewees 1 and 6 indicated that they accessed from the intervention programme from home because they did not have sufficient breaks at the workplace.

“Yes. No, I can't. Only at home.” (Interviewee 1)

“In the work, I only have, maybe like I told you 30 minutes like this, because we are busy here in the ward.” (Interviewee 6)

Limitations in available break time prevent nurses from engaging with the intervention programme and performing the exercises. In the case of Interviewees 7 and 9, accessing the intervention programme at home was preferable, also because there are no facilities in the hospital for practicing these exercises:

“Now I know that there's some exercise that can be done at home easily and accessible, that's why.” (Interviewee 7)

“Sometimes in my home because you need to do exercise in the home, not in the work” (Interviewee 9)

Some nurses preferred to access the WBI-BACK intervention programme at work, and technical support such as good Internet connection was the main reason. Interviewees 3 and 7 stated:

“Yes, in my phone number because easily access. Maybe in Internet, sometimes I don't have internet... There is a Wi-Fi in the tower, but it's not really strong.” (Interviewee 3)

“Because the Internet is fastest here, that's why.” (Interviewee 7)

Despite some reporting accessing the WBI-BACK intervention programme at home or work separately, other nursing participants were still able to access the intervention programme both at work and at home. Interviewees 4 and 16 indicated that since they had time and Internet at home, they could access the programme after work. Thus, accessing the programme at both home and work was feasible, sometimes dependent on their free time or, at work, the shift time: *“Once at home and once at work also, like during night-time when patients are sleeping.”*

(Interviewee 14)

“Actually sometimes at work and sometimes at home according to my free time.”

(Interviewee 16)

Weekly reminder emails were also a facilitator in engaging in the WBI-BACK intervention programme. Most of the nursing participants considered them as a reminder to access the intervention programme. Interviewee 13 stated that weekly reminder emails were helpful in encouraging her to participate:

“I think it is helpful because it reminds us of engagement ...So I have to do it.” **(Interviewee 13)**

However, some of the participants highlighted that engagement in this intervention through email was time-consuming, and it would be easier to engage directly through an application intervention programme in their smartphone. Interviewee 15 expressed his feeling about the usefulness of weekly reminder emails:

“Email is not... it is not but everyday notifications from application would be more helpful.” **(Interviewee 15)**

Additionally, some nurses mentioned that they were unable to access their emails during working hours due to heavy workloads and limited computers in the wards. Interviewee 11 made this point:

“For us nurses, sometimes we cannot access our email, especially in the ward. If you see, there are only two computers, three computers... most of them are used by doctors most of the times.” (Interviewee 11)

Participants are encouraged to utilise different media to access the intervention programme, such as mobile phones. Although there are no guidelines that the modules should be accessed on a personal computer, it is evident that participants preferred to access this programme through their mobile phones when it is was necessary and when they had no access to computers.

In summary, the main contextual factor that affected how and where the nurses accessed the WBI-BACK intervention programme was the work context. Important aspects of the programme’s flexibility are the accessibility, and also the simplicity inherent in adapting to the intervention programme. The weekly reminder email to encourage engagement was also useful.

6.6.3.3 Barriers to WBI-BACK Programme Engagement

Interviews with nurses in both LBP and non-LBP groups aimed to investigate the barriers to compliance and the reasons for non-adherence to the WBI-BACK intervention programme. The main barriers to engagement in the intervention programme were job-related factors, technical factors and the characteristics of the WBI-BACK intervention programme.

6.6.3.3.1 Job-related factors

Nurses reflected on the relationship between job-related factors and their engagement in the WBI-BACK intervention programme, such as shift work and working long hours in the clinical setting as a barrier to engagement in the intervention programme.

Lack of time to access the programme was the most common barrier, and its impact on the usage of the programme varied between interviewees, both in the LBP and NOLBP groups. A

lack of sufficient time has been attributed to the professional engagement of the participants, who work as nursing staff, since the management of patients is not predictable. The time barriers had different effects on the participants. Interviewee 3 stated that:

“Because our work is very headache, the patient. I have three patients, and I do not have time to access my phone, even the internet.” (Interviewee 3)

Additionally, Interviewee 14 reported the same issue:

“Yes, it is time challenging for me. Come back from work tired, undress and you force yourself to go to the exercise. This is my barrier for me.” (Interviewee 14)

Lack of time was also cited by the nursing staff who have an administration role in the ward. Interviewee 2 stated:

“Barriers are only in my work we are busy... I’m a chairperson of nurse informatics that’s why we have a lot of things to do, focusing on the project because they leave the project till the end of this year. That’s why I forgot to exercise because I’m already focusing in our project also for the unit B.” (Interviewee 2)

Ultimately, the challenges associated with lack of time constitute additional barriers to the feasibility of the WBI-BACK intervention programme. Although the participants may have had sufficient time cumulatively, what matters is the fact that they lacked sufficient time within each session to engage in meaningful access to the intervention programme, as well as to practice the proposed interventions to an extent that was sufficient to generate any results.

6.6.3.3.2 Technical factors

The second barrier cited by participants was a lack of Internet connection. Participants who cited this barrier faced a challenge in engaging with the intervention, as they lacked a reliable Internet connection in the locations where they worked or at home. Since some participants relied on the time available during rest at home to access the intervention programme, their

lack of access to the programme was indirectly caused by a lack of time at the workplace to access the programme. According to Interviewee 2:

“I told you that sometimes, the Internet connection is not good.” (Interviewee 2)

Furthermore, other nurses lacked basic access to their mobile devices or computers, which may have been due to the cost of technology or lack of free Internet services in their local communities. The unreliability of the Internet connection at work and home represents an external factor which directly affected the ability of the nurses to access the intervention programme. Interviewee 9 mentioned this as a barrier that limited her ability to access the intervention programme, as she was unable to download all the modules due to limited data:

“Because sometimes if your load 10 GB, sometimes you don’t have Internet then...” (Interviewee 9)

Some nurses reported that the technology was a barrier for the follow-up of the WBI-BACK programme. They lacked home Internet connection, but they could access the hospital's Internet. However, they were busy at work and thus could not engage in the WBI-BACK intervention programme. Interviewee 3 stated that she was busy with patients during working hours, and there was no time for accessing the Internet:

“Busy, the patients, no time for any social media, internet like that... No cell phone for the duty.” (Interviewee 3)

Lack of broadband connection, as well as a reliable Wi-Fi signal, were also cited as barriers to access, especially considering that the most preferred point of access was their residence. Two nurses returned to their home countries (the Philippines), and they lacked a good Internet connection, so they left the study. In this regard, Interviewee 6 states:

“Maybe related to the time, too busy. Also, maybe there is no Internet connection.” (Interviewee 6)

Therefore, some nurses suggested that the programme would be useful without the requirement for Internet connection, such as an application. Interviewee 6 suggested that:

“I think if you do the application and it will remember you, every day, every hour is good. Application in the home.... The application would be without the Internet.” (Interviewee 6)

These difficulties impact nurses who use a mobile telephone to access the programme and those who use computers. Conversely, good Internet connection and availability are instrumental in making the programme more rewarding. The lack of a reliable Internet connection affected participants differently, since those who had broadband connections in their homes did not face the same challenges.

Ultimately, concerns around poor Internet connectivity of mobile devices and computers were a barrier to accessing the WBI-BACK intervention programme.

6.6.3.3 Characteristics of the WBI-BACK Programme

Overall, nurses believed that the WBI-BACK intervention programme was well-structured and informative. However, some of the nursing participants cited the long modules of the WBI-BACK intervention programme and its complexity as a barrier. The inability of the participants to engage in all modules in the WBI-BACK intervention programme is determined by specific characteristics thereof. This complexity arises from the fact that the intervention programme is structured in modules which have to be completed in their entirety to understand the self-management strategies. One participant thought there was a large amount of content within the WBI-BACK intervention programme, and that it needed to be better summarised. Interviewees 2 and 7 noted:

“There’s a lot of wards, like that, that sometimes you feel sleepy when you read it, like that. I think I want more easy to use. What is it? It is easy to read, sometimes, what people like that, summarise, yes, easily summarise that one.” (Interviewee 2)

“Make it strong. We need something short, fast.” (Interviewee 7)

Ultimately, these challenges (job-related and technical factors) resulted in a lack of consistency in accessing the intervention programme, progressing through the content and adhering to the proposed interventions, such as exercise and physical activity.

Other causes of complexity arose from the language used. The language used in the WBI-BACK intervention programme was viewed as a barrier, especially for those whose mother tongue is not English. The intervention programme is designed in English, which was not the native language of the participants. Based on the interactions during the interview, the participants displayed a reasonable degree of proficiency in the English language. However, some of the participants expressed the view that the language used in presenting the content presented a challenge, especially since it necessitated extensive concentration, and often participants lacked sufficient time for that. For example, Interviewees 16 and 10 stated:

“I think if it's in Arabic language it would be easier for somebody because not all the people have an excellent English language.” (Interviewee 16)

“As you know, during that time when I visited the website, I was with my family. My family, they couldn't read the information, I try to explain everything to them about the website. It's good to be Arabic, the programme.” (Interviewee 10)

As a result, although most nurses are proficient in English, it would be preferable for the WBI-BACK intervention programme to be in Arabic for Saudi nurses. However, this limitation did not affect the participation of the nursing staff in the institution who speak English as a first language.

The inclusion of audio and visual components helped the participants deal with the language-related challenges. The videos and images are considered as self-explanatory, and they

introduce a novel element of education for the participants. This is essential for the demonstration of the exercises and physical activities, as well as other interventions for preventing and reducing LBP. However, it is unclear whether these advantages lead to reduced preference for text-based content. Interviewee 13 stated that the images and the videos were self-explanatory:

“Yes, it is useful. It can be easily guided too. The images, you can just easily follow it, like some instructions on how to do that exercise. It can be easy to follow.” (Interviewee 13)

Based on these findings, it is apparent that the barriers to using the WBI-BACK intervention programme arise from both external factors (job-related factors) and internal factors (technical characteristics of the WBI-BACK intervention programme). The role of the perceived benefits and engagement explain differences at an individual level, including motivation and desire to manage LBP.

6.6.3.4 Suggestions for Improvement to the WBI-BACK Programme

The participants provided suggestions for the improvement of the WBI-BACK intervention programme, based on the barriers to access and use of the intervention programme. Participants proposed that the intervention programme should be improved through the inclusion of effective mechanisms for reminding them to access the intervention programme. Such an improvement would remedy some barriers to access, starting with the tendency of the participants to only access certain modules, and failure to access the modules or the programme as frequently as they should. The proposed reminders are also needed for activities included in the interventions, such as exercising and physical activities. Considering that most of the participants do not have specific knowledge about exercising, there is a need for better guidance on how, when and where to exercise. The lack of such guidance is apparently a contributing

factor to widespread LBP among the nurses. Interviewee 12 suggested a simple course before engagement in the WBI-BACK intervention programme:

“I think the best way to give the education to the nurse through a simple course like that... and a lot of nursing will be very interested with this because a lot of nurses here are really suffering from back pain like 90% to 95%.” (Interviewee 12)

The reminders and notifications should be improved, as the weekly reminders were not effective enough. Most of the nurses suggested an application programme (App) for LBP self-management intervention to enhance their engagement. Many nurses specifically expressed their willingness to receive daily reminders through their smart phones without Internet connection to improve their engagement. Interviewees 15 and 10 suggested:

“Every day there is notifications from the application would be more helpful.” (Interviewee 15)

“To be like application. To be easy for each other to use it in the phone, even now, it’s in the website, it’s not easy to put as a website.” (Interviewee 10)

“I think if they would generate an application through the mobile, this one just all people will benefit from this one rather than depend on the website itself. The issue, again, for me is the easy access that’s not through the computer.” (Interviewee 15)

The presence of reminders would also enable participants to schedule the particular modules to access, to ensure that they do not concentrate on accessing just the first and second modules. The use of text message reminders would increase adherence and engagement since they are not affected by a lack of internet connectivity as suggested by Interviewee 3:

“Maybe text message. Yes, in my phone number because easily access. Maybe sometimes I don’t have Internet.” (Interviewee 3)

There were also suggestions to integrate assistance for the WBI-BACK intervention programme to assist those participants who face challenges. The participants reported some barriers in accessing and utilising the intervention programme (see section 6.6.3.3). The researcher was available at any time to answer any questions from the participants during the 6-week intervention period through emails, while one participant sought help from elsewhere. Although this was an isolated instance, it indicates a significant challenge with the intervention programme, in that the participants were (fundamentally) left to understand the programme and engage in activities that did not involve commonplace knowledge. Interviewee 14 stated that:

“Yes. If I don't understand I ask my coach in the gym to explain to me how to do it.” (Interviewee 14)

Finally, it has been suggested by 3 participants that information pamphlets demonstrating what the WBI-BACK intervention programme is and how to do exercises and PA could be useful and beneficial. Pamphlets are easier to carry and use, more convenient and not affected by challenges in access to the Internet. Some of the nursing participants suggested the availability of hard copies of the exercises alongside the intervention programme could be useful. This was preferred by nurses who wanted to access certain modules for short durations but did not have time to log in to their computers or mobile phones. Interviewees 4 and 13 supported the idea of using some pamphlets and written options:

“I would suggest if you can give us some pamphlets, if you can provide some pamphlets and writing.” (Interviewee 4)

“There are some leaflets, pamphlets that we can carry,” (Interviewee 13)

In summary, these suggestions have multifaceted benefits, since they solve the challenge of lack of time (such as forgetfulness and lack of motivation), the perceived ease of use (by guiding the nurses to visit different modules to cover all the content) and enhancing the perceived usefulness (by encouraging the nurses to engage in the all proposed modules in the WBI-BACK intervention programme).

6.6.3.5 Recommendation of the WBI-BACK Programme to others

With regards to nurses’ engagement, most of the nursing participants recommended the WBI-BACK intervention programme to other colleagues in the same profession or other family members. The findings from the interviews provide evidence that nursing participants experienced high levels of engagement and enjoyment. Some nurses expressed that the WBI-BACK intervention programme was appropriate for other colleagues depending upon their time and setting. Equally, some of them welcomed new intervention programme technology and were eager to share it with their friends and colleagues. Thus, they thought that the WBI-BACK intervention programme was useful, acceptable and helped them in self-management of LBP. Interviewee 4 highlighted that she could help her colleagues to reduce LBP symptoms:

“I may help my colleagues also in future who might be having or complaining of LBP, I will tell them to follow this thing so that can also be free from LBP.” (Interviewee 4)

There were also recommendations from some participants to share the WBI-BACK intervention programme with other family members, especially those who have LBP, to enhance the usefulness of the intervention programme. For example, Interviewee 12 clearly expressed her eagerness to share the information and knowledge in the WBI-BACK intervention programme:

“... I’m sharing the knowledge that I have learned to my family members. Especially to my father because I told him, ‘Dad, it seems you have also back problem. It will also beneficial for you to do this type of exercises.’” (Interviewee 12)

Furthermore, some participants showed their willingness to recommend this intervention programme to their family members and share the videos and images in order to help them to prevent and self-manage LBP. For instance, Interviewee 7 clearly stated that she could recommend this programme to her mother:

“Yes, especially with my mother. I will definitely show the videos to my mother.”
(Interviewee 7)

These results show the therapeutic connection between healthcare professionals and this new WBI-BACK intervention programme, which emphasises the clinical advantages of this intervention programme. Therapeutic perceptions were affected by the usefulness, the usage and the engagement of the WBI-BACK intervention programme.

6.6.4 Theme 4: Nurses’ attitudes towards the WBI-BACK Programme

The WBI-BACK intervention programme is designed for nurses to help them to manage and prevent their back pain. Importantly, nurses’ satisfaction about the design and delivery of the digital intervention is essential to enhance their engagement. In this study, most nursing participants expressed positive feelings towards the WBI-BACK intervention programme, reflecting a broad range of participants’ abilities and preferences. They reported that the WBI-BACK intervention programme was easy to use and helped them to increase their knowledge about LBP and exercising. Interviewee 13 clearly stated the positive attitude toward the WBI-BACK intervention programme:

“It is helpful, because you can see everything from the history of the back pain down to the implementation.” **(Interviewee 13)**

Additionally, most of the nurses expressed positive attitudes about the design of the technology used in the WBI-BACK programme. The interviewees indicated that the images, videos, and interactive elements were useful (see Theme 1, section 6.6.1.2).

Similarly, participants indicated a positive attitude towards the knowledge acquired from the programme, which could inform decisions that help them reduce LBP, such as correct lifting and manual handling techniques, according to Interviewees 9 and 12:

“... give me a lot of knowledge how to manage and to intervention my lower back pain.”

(Interviewee 9)

“It is reminding me... if the pain is occurring... I have to be careful utilising my back always.” (Interviewee 12)

The positive attitudes expressed by NOLBP participants were similar to those in the LBP group. The participants were, however, more interested in the prevention of LBP. The programme offers similar solutions in terms of knowledge and intervention in the form of exercise and physical activity to both groups. Consequently, the NOLBP participants enjoyed similar benefits, including the ability to help others, prevent the onset of LBP, acquire knowledge on prevention and self-management of LBP, and increase their physical activity. Interviewees 5 and 6 stated the positive attitude toward the education and exercises in the WBI-BACK intervention programme:

“Yes, for the education and for seeing what the exercise is for... Do it for the back pain.”

(Interviewee 5)

“I don’t have back pain. but yes, maybe I will use it sometimes then.” (Interviewee 6)

In summary, participants with LBP had positive attitudes towards the use of the WBI-BACK intervention programme, and participants with no history of LBP also had similarly positive attitudes.

6.7 Chapter Summary

The aims of the semi-structured qualitative interview were to explore and understand the nurses' experience and opinions of using the WBI-BACK intervention programme, and in particular its acceptability and usability, as well as their suggestions for improvement in the context of the nursing population. It is apparent from the qualitative interviews that most of the nurses were very positive about the usability of the WBI-BACK programme, in terms of content and technical characteristics, as well as its usefulness and relevance to their lives. Nurses engaged with the WBI-BACK intervention programme, although the level of engagement varied within the group. Whilst the qualitative data in this feasibility study was used to explore the experiences and views of the participants, the poor data from the qualitative interviews may affect the sample representativeness in the qualitative evaluation.

Although there were minor barriers and challenges in terms of engagement with the WBI-BACK intervention programme, it helped most nurses to enhance their knowledge of LBP self-management, and/or to decrease their LBP. Importantly, the findings imply that there was a lack of knowledge regarding PA among the nursing population, which significantly affected the WBI-BACK intervention's usability in terms of increasing their PA level and setting a weekly plan. The next chapter will present the process evaluation and its results for this feasibility study.

Chapter 7: Process Evaluation of the Feasibility Study

7.1 Introduction

The previous chapters in this study have revealed the development of a theory-informed web-based intervention programme (WBI-BACK programme) for nursing populations to enhance behavioural self-management of LBP, as well as the methodology and procedures that were used to assess the feasibility and acceptability of the WBI-BACK intervention programme for nurses with and without LBP. This study primarily aims to investigate the feasibility and acceptability of a WBI-BACK intervention programme developed for preventing and treating LBP among a nursing population in the KSA, which it is hoped will provide a basis from which to inform a decision on whether a full study (i.e. on a wider, national scale) is feasible. This is the first study of its kind to assess the feasibility of using a digital intervention programme for nurses in the KSA. This feasibility study secondarily aims to identify potential changes in outcome measures and to determine the most appropriate outcomes to assess the delivery of the WBI-BACK intervention programme to nurses in a future clinical trial. The MRC framework highlights the importance of undertaking a process evaluation of the intervention (Craig et al., 2008). Feasibility studies have previously been used to decide if an intervention is suitable for further testing (Bowen et al., 2009). Furthermore, feasibility studies acknowledge appropriate interpretations and conclusions drawn from the positive and negative results, and can help to determine the differences between observed and expected outcomes (Reelick et al., 2011). This chapter discusses the process evaluation methods of the feasibility study to evaluate both the research processes and the intervention, based on quantitative and qualitative results. Following this discussion, an assessment of the intervention and conclusions are presented.

7.2 Triangulation of Quantitative and Qualitative Results

Integrating quantitative and qualitative data in MMR research has developed into a multidisciplinary field of investigation (Tashakkori and Creswell, 2010). MMR is growing in acceptance and prevalence in the literature and has been focused on complex research questions through different disciplines (Tashakkori and Creswell, 2010). Within MMR literature, the issue of triangulation of quantitative and qualitative data is receiving more attention. Studies have mapped many triangulation techniques used by the researchers and evaluated the challenges and limitations related to integrating quantitative and qualitative data (Onwuegbuzie and Teddlie, 2003; Creswell and Plano Clark, 2011). In sequential MMR, researchers have a collection of quantitative and qualitative data in two stages and tend to use iterative integration strategies that highlight links between the study's stages (Plano Clark, Garrett and Leslie-Pelecky, 2010). On the other hand, when using a concurrent MMR design, researchers collect, analyse and integrate data from both quantitative and qualitative stages within one phase of research to deliver complementary or corroborating information in which quantitative and qualitative data are directly compare or linked to each other (Tashakkori and Teddlie, 2010; Creswell, 2013). The importance of triangulation in concurrent approaches exceeds the summation of quantitative and qualitative evidence in the dynamic merging of the two types of data, which is more than the sum of one part (Plano Clark et al., 2010). Therefore, the value of concurrent MMR can be realised when the researchers use an effective merging approach in their research.

Data integration is a crucial component of MMR analysis and conceptualisation. It has three essential objectives: illustration, convergent validation and the development of analytic density (Fielding, 2012). Additionally, combining data effectively needs a deep understanding of the threats and risks to validity inherent in the mixed methods, especially in social-behavioural

research (Fielding, 2012). In this study, two methods were used to triangulate findings and enhance the reliability of the research conclusion.

Integration within concurrent MMR has some limitations. Literature notes that integration in concurrent MMR is problematic because it is essentially difficult to compare findings from different types of data, thus because the quantitative and qualitative data could present different phenomena (Creswell, 2013). However, methodologists have provided guides for integrating within concurrent MMR (Onwuegbuzie and Teddlie, 2003; Creswell and Plano Clark, 2011) and summarised this literature and reported three plans used to integrate quantitative and qualitative data: (1) integrating with a discussion, (2) integrating with a matrix and integrating by data transformation (Plano Clark et al., 2010).

In the current study, integration with a discussion has been used, which is the main item of the whole discussion (Chapter 8). This approach has often been used in the MMR with the intention of complementarity. Implementation of this approach followed five stages (Plano Clark et al., 2010). First, the quantitative and qualitative data sets were analysed separately to attain the results and investigate the available information. Second, identify the overlapping area to suggest topics that could be successful for comparing the two results. Third, enhance the analyses in overlap areas from two results based on what has been learned from these comparisons. Fourth, compare the quantitative and qualitative results directly and examine how the data sets demonstrated and supported each other. Finally, write a paragraph that reports particular results from one set of data, followed by corresponding findings from other data, and discuss the interpretations about how the findings from one data illustrate and corroborate the results and answer the research questions. Some researchers use this strategy by reporting quantitative results in one paragraph and following it with another paragraph to include corresponding qualitative results, while others report descriptive quantitative findings and immediately report a qualitative quote within the same paragraph (Plano Clark et al., 2010).

These five stages was addressed in the current study as the quantitative and qualitative data analysed separately (Chapter 5 and Chapter 6). The integration process included combining numeric information from the quantitative data with the texts from the qualitative data. Integration was achieved through reporting results together in the process of evaluation of the feasibility study and assessed through predetermined progression success criteria related to recruitment and retention rate, completeness of outcome measures, exposure to the intervention and acceptability of the intervention (Herbert, Julious and Goodacre, 2019; Hawkins et al., 2017). The following sections report the integration results. One of the limitations of reporting the triangulation between the quantitative and qualitative results in this study is poor and superficial qualitative data; thus, it could affect the study result. Future studies should focus on strategies to enhance the qualitative response from nursing participants in Saudi Arabia.

7.3 Process Evaluation Method

Feasibility studies are an important process for developing any new intervention. The Standard Protocol Items: Recommendations for Intervention Trials Items (SPIRIT) defined a feasibility study as '*Can this study be done?*' (Chan et al., 2013). The consolidated standard of reporting trials statement extension to pilot and feasibility trials was followed in the design and planning of the study and writing of the protocol (Eldridge et al., 2016; Eldridge et al., 2013).

The assessment process of the intervention can help to describe why some interventions are more successful than others, and how they can be improved. The assessment process of the intervention within the research process can help to explain whether an intervention is successful and how it can be optimised (Reelick et al., 2011). There were no proposed standards to guide the assessment of feasibility studies in the literature (Bowen et al., 2009). Reelick et al. (2011) highlighted the process assessment for previous studies on complex interventions as structured into these three main components: (1) the study population, (2) the data collection

procedures, and (3) the way that complex intervention was conducted. This standardised framework was adapted for the current feasibility study to perform the process assessment for the feasibility study to assess both the research processes and the interventions. The three main components addressed in the current study were intended to focus on the usability and acceptability of the WBI-BACK, rather than forming conclusions about the effectiveness of this intervention (Moore Graham et al., 2015). Table 27 illustrates the main assessment component and its related variables, and the measures of an intervention modified from Reelick et al. (2011). The purpose of feasibility studies on behavioural and social interventions centre on five principal objectives: 1) assessment of recruitment experience and sample characteristics, 2) assessment and improvement of data collection processes and outcome measures, 3) assessment of the suitability and acceptability of the intervention and study process, 4) assessment of the resources and capability to implement and manage the intervention and the study, and 5) initial assessment of participants' responses to intervention (Orsmond and Cohn, 2015). The details of how primary feasibility objectives are assessed are presented in Table 28. A detailed process evaluation was collected from both quantitative and qualitative data, and both were used to assess the objectives of the feasibility study.

Table 27: Process Assessment Components and Related Variables and Measures of an Intervention (modified from Reelick et al., 2011)

Process components	Process measures	Process variables
Research procedures: Study population	Recruitment and response rate	• Number of participants recruited each week
	Facilitators and barriers to recruitment procedure	• Potential strategies to increase participation • Causes for non-participation • Experience of recruitment: time spent to recruit.
	Follow up rate: Attrition rate	• Total number of participants at completion against number at start
	Facilitators and barriers for follow-up	• Causes for dropout • Motivation for continuing participation
Research procedures: Data collection procedures	Completeness of data collection	• Characteristics and numbers of missing data • Causes for missing data • Feasibility of outcome-measures to detect changes over time
	Facilitators and barriers to data collection	• Rate of questionnaire completion • Time needed to collect and analyse data
Intervention procedures: Intervention implementation	Delivery of the intervention	• Fidelity of the delivery of the intervention
	Facilitators and barriers to delivery of the intervention	• Experience of intervention implementation • Experience of intervention based on researcher reflection
	Intervention engagement	• Number of sessions engaged with in the WBI-BACK programme • Maintenance of records of weekly physical activity in the physical activity diary sheets
	Facilitators and barriers to intervention engagement	• Causes for non-engagement with the intervention or maintenance of diary sheets of physical activity

Table 28: Assessment of Feasibility Objectives (modified from Orsmond and Cohn, 2015)

Feasibility Objectives	Measures to Assess Particular Objectives	Feasibility Assessment
1. Recruitment rate	-The total number of participants screened for eligibility and recruited will be recorded during the recruitment process. -The average time taken to recruit participants in the study will be recorded. -Reasons why participants were ineligible for study inclusion will be recorded.	-The number of participants screened, who were eligible, who consented to participate, and who refused to participate will be recorded. -Reasons for exclusion will be collected.
2. Sample characteristics	- The sample characteristics of the study participants will be recorded.	-The sample characteristics will be recorded.
3. Facilitators and barriers to recruitment procedure	-Motivation and reasons for declining participation will be recorded during the recruitment process. -The experience of participants will also be recorded.	-Reasons for motivation and refusal of recruitment will be collected.
4. Follow-up rate and attrition rate	-The total number of participants completing follow-up against the number who started the study will be recorded for both groups (LBP and NOLBP) as well as the percentage. The reason for participant attrition will be recorded for both groups.	-The number of participants who completed follow-up will be computed for each group separately, and also the percentage.
5. Completeness of outcome measures	-The experiences and time taken to complete the outcome measure questionnaires will be recorded for both groups (LBP and LBP) separately. The number and characteristics of any missing data will be calculated. -The feasibility of outcome measures to identify the changeover time will be reported for both groups.	-The average time to complete the questionnaires will be computed for both groups. The frequency of missing data will be also counted. Reasons for missing data will be reported.
6. Intervention engagement	-Intervention engagement will be assessed from the participants' engagement in the WBI-BACK intervention programme at least once. -Participants will be asked how many times they accessed the	-Total participant engagement times with the WBI-BACK intervention programme will be calculated for both groups, as well as the modules accessed. -The record of PA diary sheets will be collected from all participants and

	intervention programme, and the results will be recorded. -Self-reported usage data regarding which modules they have accessed in the WBI-BACK intervention programme will be recorded. -Engagement will be also assessed if the participants are able to maintain a record of weekly PA diary sheet, set their goals and discuss them with the researcher through email.	analysed based in their individual goals. -Deviation from the intervention protocol will be reported. -The reasons, barriers to non-treatment adherence and the facilitators for adherence will be also explored.
7. Experiences of the intervention components based on TAM	-Experiences of the intervention for all participants will be assessed based on their responses to the TAM questionnaires. -The questions based on ease of use, usefulness and attitude to the use of the WBI-BACK intervention programme. Answers to these questions is on a five-point categorical scale (1= Strongly agree; 2=Mostly agree; 3=Don't know; 4=Mostly disagree; 5=Strongly disagree). -The results from qualitative data will be assessed to explore the acceptability and usability of the intervention programme.	-The total numbers and percentages will be counted for all questionnaires in both LBP and NOLBP groups. -Thematic analysis will be used to analyse the qualitative data from the participants.
8. Satisfaction of the intervention	-Treatment satisfaction will be assessed based on the findings of the qualitative interviews of the participants.	-Thematic analysis will be used to analyse the qualitative data from the participants.
9. Perceived intervention acceptability	-Acceptability will be assessed based on the findings of the qualitative interviews of the participants.	-Thematic analysis will be used to analyse the qualitative data from the participants.

7.4 Criteria for Feasibility

The selection of success criteria was based on the following traffic light assessment system: 1) red= stop, i.e. discontinue a full study if any pre-planned changes could not help promote feasibility; 2) amber = amend, i.e. modify the study protocol further before conducting a full study without another feasibility assessment, 3) Green = proceed, i.e. continue to a full study, as it is in the feasibility study, without amendments (Hawkins et al., 2017; Abbott, 2014). This was demonstrated previously in Chapter 4, section 4.7, Table 14.

7.5 Results

7.5.1 Research Procedure

Assessment of the research procedures provides an understanding of the recruitment success rate and the quality of the study sample alongside the data collection procedures (Reelick et al., 2011). Therefore, the following section will discuss the research components to evaluate whether the research procedures were successful.

7.5.1.1 Study population

The study population is extensively explained in Chapter 5, section 5.4. These sections explained the characteristics of the population, with specific consideration for details related to the process evaluation. Assessment of the study sample is important to determine the success of the research participant selection (Orsmond and Cohn, 2015). It gives insight into the recruitment and response rates, eligibility criteria, barriers and facilitators to the recruitment procedure, and how relevant the intervention is to the purposed study sample (Orsmond and Cohn, 2015).

7.5.1.1.1 Recruitment and Response Rate

Recruitment rate is defined as the number of eligible nurses who enrolled in the study out of those who were approached. The major question to ask about the first feasibility objective is: ‘*Can we recruit appropriate participants?*’ (Orsmond and Cohn, 2015). It has been stated that one of the feasibility outcomes of the current study was to evaluate the strategies used to recruit participants. The recruitment process started from 1 October 2019 and ended on 30 December 2019. The recruitment process was conducted using a direct recruitment method (face-to-face strategy) and an advertisement disseminated through the announcement boards in each ward. In addition, study advertisement was undertaken in a short meeting on each ward by the PR. There were 206 nurses in the data collection centre (Rehabilitation Hospital at KPMC). The

PR approached 80 participants who were invited to the study; of these, 62 (77 %) agreed to participate, and only 53 (66 %) were found to be eligible and signed the written consent forms. The 53 nurses who met the inclusion criteria were allocated to the LBP or NOLBP groups based on the self-report of the presence of LBP). Thus, 35 (66%) were allocated to the LBP group, and 18 (34%) were allocated to the NOLBP group.

Thus, in this study, it was determined that it was feasible to recruit 40-50 target participants within the planned study period (3 months), and the eligibility criteria were appropriate and feasible to recruit nurses with and without LBP. The average recruitment rate was three participants per day in the first two weeks, then it decreased to one participant in the remaining 10 weeks. Assessing the sample characteristics is essential to determine whether the proposed intervention is feasible for the study participants (Orsmond and Cohn, 2015). Twenty-two participants in the LBP group were females aged 20–50 years, while eight participants were males in the same age group. In the NOLBP group, only 11 participants were females, compared to four male participants (all aged 20–50 years). Specifically, the vast majority of participants in the LBP group (63.3%) were aged 30–39 years, while most participants in the NOLBP group (60%) were aged 20–29 years. A considerable variation in the age groups reflected the high LBP prevalence among nurses that increased in prevalence by age, which agreed with results from previous studies (Keriri, 2013; Azizpour et al., 2017; Jradi, Alanazi and Mohammad, 2020). The sample characteristics concurred with what was found in the research literature among nurses with LBP in the KSA (Jradi et al., 2020). This data helped to assess the feasibility of the proposed recruitment plan and research process.

7.5.1.1.2 Facilitators and Barriers to the Recruitment Procedure

Understanding the motivation strategies that encourage participants to be involved in the research can help towards engagement in research studies (Reelick et al., 2011). One of the main reasons for a willingness to participate in the study was the presence of LBP. Nurses with

LBP were more motivated to participate than those without LBP, as shown during the direct recruitment method (face-to-face strategy). Most of the nurses with LBP asked the researcher before the recruitment process how this programme would help them to manage their back pain. Specifically, interviewed nursing participants expressed their motivation to participate in this study to help them to reduce their back pain, as they were healthcare professionals and lacked time to tackle their back pain. Interviewee 15 clearly stated that:

“On daily basis, we have work as nurses, sometimes we’re not taking care of ourselves but in this case just to remind us and give message how to take care.” (Interviewee 15)

In addition, Interviewee 2 stated that her motivation to participate was working in a Rehabilitation Hospital, as she had developed back pain when lifting and transferring patients:

“When I transfer here in rehabilitations because before I’m in surgical male ward. Because here in rehabilitation it’s more lifting the patients, transferring, like that, that’s why it’s becoming more, sometimes I experience a lot of back pain.” (Interviewee 2)

Recruitment was enhanced by nurses consistently stating that they did not want to take medication for their LBP, preferring to engage in conservative treatment and strategies such as exercises. This was mentioned as the main benefit of the engagement in the WBI-BACK programme. Some nurses were motivated to participate in learning new strategies, especially exercise therapy, to treat their back pain. Interviewee 8 stated:

“Now we know how to protect our back and now we know some exercises that can lessen our back pain.” (Interviewee 8)

Others indicated that their motivation to participate in this intervention was to use an innovative approach as a new experience for LBP management and prevention, and this has been reported in the research diary. Another facilitating factor for recruitment was the encouragement from the head nurse on each ward for the nurses to participate. In some departments, the head nurses supported the researcher and encouraged their staff to participate in the research as a means to

promote a healthy lifestyle for the nurses. This encouragement was done by allowing the researcher to attend a daily meeting with all morning and night shifts explaining the research strategy and benefits to encourage participation and this was discussed in Chapter 4, section 4.4.3). There were variations in the recruitment rate across the department (Table 30); it was higher in wards 3 and 4 (neuro inpatient rehabilitation, and stroke and traumatic brain injury) than wards 1, 2, and 6 (spinal cord inpatient rehabilitation, stroke inpatient rehabilitation, and paediatric rehabilitation, respectively). Some nurses in the qualitative interview also suggested that they should receive a certificate to be included in their CV from the higher administration and research department when they participate in any research to encourage their recruitment. Although professional colleagues and organisations helped to facilitate the recruitment process, there were some barriers to enrolment. Time pressure was the most important barrier to participation in the study (see Chapter 6, Theme 3, section 6.6.3.3). Interviewees 13 and 16 stated that long working hours for nurses was a barrier to participation:

“We are working for 12 hours, so sometimes, if it is busy, you do not have time to scroll with your phone.” (Interviewee 13)

“Actually, the time restrictions is the main barrier as we are working for long hours and when we go back home, we have many responsibilities at home.” (Interviewee 16)

The mean time taken for recruitment, including the screening process and time to sign the consent form, was 15 (SD 6; range 6–45) minutes. The time varied between the department sites and was affected by the time and day of the recruitment. For example, the recruitment took longer in the early morning when the morning shift started, and at the start and end of the week (Sunday and Thursday), while recruitment time was shorter in the middle of the day and mid-week.

Table 29: Recruitment Sample Characteristics Related to Department Site

Sample Characteristic	*LBP Group N=35	*NOLBP Group N=18	Total N=53
All participants	N=35 (66%)	N=18 (34%)	N=53 (100%)
Working Department			
*Ward (1)	3 (9 %)	3 (17 %)	6 (11 %)
*Ward (2)	7 (20%)	6 (33 %)	13 (25 %)
*Ward (3)	13 (37 %)	1 (6 %)	14 (26 %)
*Ward (4)	9 (26 %)	3 (17%)	12 (23 %)
*Ward (6)	1 (3 %)	0	1 (2 %)
*OPD	1 (3 %)	5 (28 %)	6 (11 %)
Administration	3 (9 %)	0	3 (6%)

*Ward (1): Spinal cord inpatient rehabilitation

*Ward (2): Stroke inpatient rehabilitation

*Ward (3): Neuro inpatient rehabilitation

*Ward (4): Traumatic brain injury

*Ward (6): Paediatric rehabilitation

*OPD: Outpatient rehabilitation

7.5.1.2 Follow-up and Attrition Rates

The attrition rate is defined as the number of participants who drop out of the study. In this feasibility trial, of the 53 participants who agreed to participate, only 45 (85%) completed the trial; the total attrition rate was 15% (9% in the LBP group and 6% in the NOLBP group). The follow-up rate from the questionnaire per sample size was 30 (86%) for the LBP group and 15 (83%) for the NOLBP group. Eight participants (15%) dropped out: one nurse left the Rehabilitation Hospital at KFMC, two nurses were on annual leave and did not respond to their emails, and three of them moved to a different ward within KFMC Hospital and did not respond to their emails. The last two refused to fill out the post-intervention questionnaires due to time work pressures. Therefore, the follow up rate in this study was 85% (45/53), which is

acceptable according to the previous literature; the response rate for scientific studies varies between 68% and 75% (Neuman, 2014).

Understanding what motivates nurses to continue the 6-week intervention can help to retain those who were less likely to remain during a research study. Interviews with nurses revealed the barriers and suggestions that might improve retention and engagement with the WBI-BACK intervention programme, and this was explained previously in Chapter 6, Theme 3, section 6.6.3). The main barrier to the follow-up of the WBI-BACK intervention programme was time; nurses reported not having enough time to engage in the intervention programme and complete the post-intervention outcome measures after 6 weeks. Importantly, time pressures and stress at work were reported by three nurses. For example, Interviewee 12 expressed this feeling:

“I was really stressed at work at the time that I really had no time to do any other exercises... mostly stressed from work. I get depressed also.” (Interviewee 12)

Additionally, Interviewee 7 explained that poor compliance was another barrier for engagement in the intervention:

“I am so lazy to do any kind of exercises, that is why the barrier is the compliance because I am lazy... the compliance is really hard to sustain.” (Interviewee 7)

7.5.2 Data Collection

Assessment of the data collection procedures aimed to evaluate how appropriate the data collection process and outcome measures were for the study sample and the purposes of the study (Orsmond and Cohn, 2015).

7.5.2.1 Suitability of Outcome Measures

Six outcome measures were collected using six questionnaires described previously in the Chapter 4, section 4.5.2.2. In the previous literature, five outcome parameters were recommended: pain symptoms, back-specific function, work disability, health status and satisfaction with care (Bombardier, 2000; Deyo et al., 1998). All outcome measures selected for use in this study have been reported in the research literature and have documented acceptable validity and reliability to evaluate pain intensity, physical functioning, psychological function, health-related quality of life, self-efficacy and PA for patients with LBP (Noblet et al., 2019; Chiarotto et al., 2016b; Chiarotto et al., 2015; Geraghty et al., 2015). Furthermore, these measures are believed to be the most appropriate to evaluate the secondary study objectives, have robust psychometric properties and are suitable for use among nurses with and without LBP.

7.5.2.2 Completeness of Data Collection, Facilitators and Barriers for Data Collection

In this feasibility study, all 53 participants (35 nurses with LBP and 18 nurses with NOLBP) completed online pre-intervention measures, and 45 (85%) participants completed post-intervention outcome measure questionnaires. The follow-up rate from the questionnaire per sample size was 30 (86%) for the LBP group and 15 (83 %) for the NOLBP group respectively. All questionnaires were inserted into the Jisc online survey and completed (electronically) by the participants. Once complete, the questionnaires were checked electronically for missing data. Participants apparently had no difficulty filling out the questionnaires promptly with very little missing data. In cases where information was missing, the participant could not submit the form, and a dialogue error box would pop up on the screen. A PR was contacted once the error screen was generated, which would prompt them to chase up the missing information with the nurse, asking them to complete the missing questions. Moreover, the nature of the questionnaires depended on the sum of responses for each participant, and no missing data for

outcome measure questionnaires were observed. All participants understood the questionnaire; however, some of them needed assistance in completing the modified self-efficacy for exercise scale. It was suggested by most participants that this difficulty in understanding may be due to different participants' literacy levels. The measures were completed as intended in the feasibility research protocol.

The mean time to complete the online questionnaires at the initial meeting for the LBP and NOLBP groups was 16.8 (SD = 9.2) minutes and 11.3 (SD = 5.6) minutes respectively, while it was 14.50 (SD = 6.99) minutes in the LBP group and 12.9 (SD = 6.9) minutes in the NOLBP group post-intervention.

7.5.2.3 *Feasibility of Outcome Measures to Detect Change*

Assessment of data collection also investigated the ability of the measures to detect change in outcomes. All outcome measures questionnaires have been described previously in Chapter 4, section 4.5.2.2, and these included IPAQ for PA (Hagströmer, Oja and Sjöström, 2006), FABQ for beliefs about work and PA (Waddell et al., 1993), NRS for pain intensity (Kahl and Cleland, 2005), RMDQ for physical functioning (Roland and Morris, 1983), SF 12-item short form health survey for health status (Ware Jr et al., 1996) and SEE for self-efficacy for exercise scale (Resnick et al., 2000). The changes in all these measures before and after the WBI-BACK intervention programme were described previously in the quantitative results (Chapter 5, section 5.8). The data from the qualitative findings were used in triangulation with quantitative results to indicate whether the feasibility measures were feasible to detect change pre- and post-intervention, which will be discussed in Chapter 8, section 8.5.7.

7.5.3 Intervention Procedure

7.5.3.1 Intervention Implementation

The assessment of the intervention procedures involved investigating if the WBI-BACK intervention programme was delivered according to the research protocol, and if it was acceptable for the participants involved. The assessment procedures included the delivery of the intervention components, facilitators and barriers to the delivery of the intervention, intervention engagement, facilitators and barriers to intervention engagement and the experiences of the intervention components based on the TAM (Davis, 1989). All intervention components were delivered following the protocols and will be discussed in the following section.

7.5.3.1.1 Delivery of Intervention Components, Facilitators and Barriers for Delivery of the Intervention

The assessment of the delivery of the intervention aimed to investigate whether the WBI-BACK intervention programme was delivered as planned and identify the causes for any modifications from the research protocol. The delivery of the WBI-BACK intervention programme was reported in Chapter 4, section 4.4.5. The WBI-BACK intervention programme was delivered following the research protocols and methods approved by the Faculty of Medicine and Health Science Research Ethics Committee at the UoN. All nurses mentioned in the qualitative interview that the WBI-BACK programme was feasible and accessible for all nurses. Interviews with nurses indicated that the WBI-BACK intervention programme was delivered successfully; the intent being here that it enhanced their knowledge (of LBP self-management), increased PA and decreased LBP symptoms (see Chapter 6, Theme 2, section 6.6.2).

One of the facilitators for the delivery of this intervention was its flexibility. Technological support such as smartphone technology was also considered a success factor that influenced participant engagement with the WBI-BACK intervention programme. Using the properties in technology, such as the digital click on the screen, it was easy to navigate around the digital intervention with nurses, to enable and facilitate availability, and the participants were encouraged to utilise different media to access the programme such as mobile phones. Although there were no guidelines stipulating that the WBI-BACK intervention programme should be accessed on a personal computer, it was evident that participants preferred to access the programme through their mobile phones when it was necessary, and when they lacked access to computers in their work or at their residence. No technical difficulties or problems in the WBI-BACK programme were reported from the participants during the intervention period (six weeks), which facilitated engagement. Furthermore, this WBI-BACK programme is simple to learn and requires little skill, based on the qualitative data, so nurses could participate in this intervention using only their fingers to scroll over the different modules.

Availability of computers on each desk and a department's good network connection were considered important factors for the success of the WBI-BACK intervention programme. Smartphone technology was also a success factor for participants engaging in the WBI-BACK programme easily at any time, depending on their availability.

While it should be noted that delivery of the WBI-BACK intervention programme was feasible, there were some barriers. Lack of awareness from nurses toward the research opportunities because nurses are not aware of the research process itself as they are afraid of participating in the intervention. Therefore, in order to overcome this barrier, the PR explained the study purposes and research procedures to all nurses. Moreover, participant information sheets and invitation letters were distributed in order to support the discussion.

7.5.3.1.2 Intervention Engagement, Facilitators and barriers for Intervention Engagement

In this study, intervention engagement was measured by self-reported post-intervention questionnaires and maintaining a record of PA diary sheet during the intervention period of six weeks (see Chapter 5, section 5.7). Forty (89%) of the participants in all groups engaged in the WBI-BACK intervention programme, but they did not maintain their records of weekly PA in their diary sheets. Table 16 and 17 illustrate the details of the intervention engagement in both the LBP and NOLBP groups. Interviews with nurses with and without LBP aimed to investigate their motivation for compliance and engagement with the WBI-BACK intervention programme and also reasons for non-engagement, which was previously discussed in Chapter 6, Theme 3, section 6.6.3.

Using a simple format to deliver the intervention of LBP for nurses was generally noticed as a facilitator for engagement. Most of the nurses reported the ease of use and acceptability of this intervention programme. They explained how the calm background colours, interesting format and contents, interactive elements and ease of movement between the modules were considered important in motivating them for engagement with the WBI-BACK programme (see Chapter 6, Theme 1, section 6.6.1).

The WBI-BACK intervention programme was delivered as one package to all participants during the initial meeting, and the participants had access to this intervention for six weeks. The participants indicated that they lacked sufficient time to fully access the contents of the entire programme in one sitting, and in most cases, they could not fully access any single module in one sitting. They lacked sufficient time within each session to engage in meaningful access with the programme and to practice the proposed interventions. Although the WBI-BACK intervention programme was framed in six modules, not all modules were accessed by

the participants. Based on the quantitative results, the educational gallery, exercise gallery, and PA modules were the most popular modules for engagement for the participants, while the psychological module was less popular (Table 17). Indeed, interviews with nursing participants showed a similar result: educational, exercise, and PA modules were the most popular. Interviewees 13 and 14 stated that they engaged in the exercise modules:

“Most of the time, I am more focused on exercise and stretching.” (Interviewee 13)

“Education first. After that I begin to watch exercise and spend much time for these physical activities.” (Interviewee 14)

The qualitative data illustrated the lack of sufficient time was significant because participants could not access all modules during the study period. Consequently, there were differences in terms of participants accessing modules and the frequency of that access. The participants did not fully internalise and appreciate the contents of the modules as was intended. Interviewee 16 stated:

“I go to the educational module at the beginning... Then I go through exercises. The new thing for me is the physical activity... This module I go through is the last.” (Interviewee 16)

There is a possibility that the participants did not internalise the contents in those modules because they rushed through the content. Interviewee 4 stated:

“It depends. If I get time, I will continue with that or else I may skip one module and then I will go border.” (Interviewee 4)

The interplay between insufficient time and accessing all modules in the WBI-BACK intervention programme was considered a barrier facing the participants. The outcome was a decrease in perceived actual benefits from accessing multiple modules. The challenges associated with lack of time were identified as the main barrier to the feasibility of the WBI-BACK programme. The participants indicated that the lack of sufficient time to access the programme was the most consistent barrier (see Chapter 6, section 6.6.3.3). The lack of

sufficient time has been attributed to the professional engagements of the participants, who work as nursing staff. Interviewee 16 stated that:

“Actually, the time restrictions is the main barrier as we are working for long hours and when we go back home, we have many responsibilities at home. I am trying to find free time at work during my breaks, for example, or when I go back home. The main barrier is the time.” (Interviewee 16)

The second barrier cited by participants arose from a lack of access to an Internet connection. Participants who cited this barrier faced a challenge in engaging with the intervention, as they lacked a reliable Internet connection in the locations where they worked or at home. Since participants relied on the time available during rest at home to access the programme, the lack of access to the WBI-BACK intervention programme was indirectly caused by a lack of time at the workplace to access the programme. According to Interviewee 2:

“I told you that sometimes the Internet connection is not good.” (Interviewee 2)

The lack of a reliable Internet connection affected participants differently, since those who had broadband connections in their homes did not face the same challenges, and this barrier will be explained further in the discussion chapter.

Ultimately, these challenges resulted in a lack of consistency in accessing the intervention programme, progressing through the content and adhering to the proposed interventions, such as exercise and PA. This lack of consistency accounts for the disparity in awareness about the programme, as well as attitudes towards its use. These aspects will be further discussed in the Chapter 8.

7.5.3.2 Experience of the Intervention

Understanding the nurses’ experience of the WBI-BACK intervention programme is important as it provides a better understanding of the factors that motivate nurses to engage in this intervention programme. Experience of the intervention for the participants was assessed based

on their responses to TAM questionnaires (Table 18, 19, 20). Additionally, nurses' experiences of the WBI-BACK intervention were explored through qualitative interviews, which aimed to explore satisfaction, perceived acceptability, benefits and recommendations for implementation of the programme.

Among the LBP group, some participants reported that they benefitted from the intervention programme by experiencing a reduction in LBP; however, the quantitative data shows increased intensity of LBP after engagement with the WBI-BACK intervention. This variation in the results can be attributed to several secondary reasons, such as the extent to which the participants reported this issue, and this will be discussed in Chapter 8. Firstly, the extent to which they reported a reduction in LBP depends on the quality and quantity of knowledge gained about the prevention and interventions for LBP from the programme (see chapter 6, Theme 2, section, 6.6.2). Participants stated that the knowledge they acquired from using the programme helped them to better understand the causes and interventions for LBP. Interviewee 9 expressed her feeling toward the WBI-BACK intervention programme:

“... gives me much knowledge on how to manage and intervene on my lower back pain.”

(Interviewee 9)

Participants also reported a reduction in LPB due to increased knowledge about the causes of LBP from the contents of the WBI-BACK intervention programme. In particular, participants learnt that LBP is caused by occupational hazards such as long hours at work, lifting patients and lack of enough rest among others. This awareness about the cause-and-effect relationships induced changes in the behaviours of some of the participants. Interviewee 4 stated that:

“I follow the instructions what I have to do when I am handling my patients... Now I feel slightly reduced.” (Interviewee 4)

The benefits of the intervention programme to the nurses with NOLBP were like those in the LBP group. The participants were more interested in the prevention of LBP. However, the

intervention programme offers similar solutions regarding knowledge and interventions such as education, exercise and PA to both groups. Consequently, the NOLBP participants enjoyed similar benefits, including the ability to help others to prevent the onset of LBP, acquire knowledge on prevention and management of LBP and increase in PA. Interviewee 5 stated that:

“Yes, for the education and for seeing what the exercise is for the... Do it for the back pain.”

(Interviewee 5)

Despite their situation, the NOLBP group stood to benefit from the intervention programme as much as the LBP group.

7.6 Summary of the Progression Feasibility Criteria

This feasibility study aimed to explore if it would be feasible to deliver the WBI-BACK intervention programme for nurses working in a Saudi hospital and identify any modification that might be needed before attempting a larger trial. The results for the current progression feasibility criteria are presented in Table 31. These results will show if the study design and the intervention is feasible and will inform the decision to progress to a full study. Three out of five a priori progression feasibility criteria; recruitment rate, attrition rate and experience of the intervention components, were in the green zone (Table 30). Feasibility of other outcome measures were within the amber progression area, indicating the modification of some outcome measures (NRS, FABQ, SF12 and SEE) to be sensitive to detect the change (Table 30). Although the qualitative data exposed some barriers and provided insight regarding engagement with and adherence to the WBI-BACK intervention programme and why the participants did not keep a record of their physical activity and set their goals, it was apparent that further modification of the study protocol was required. These results suggest that a clinical

trial to assess the acceptability of the WBI-BACK intervention programme on a wider scale for nurses in the KSA was feasible.

7.7 Recommendations for Future Feasibility RCTs

We aimed to determine whether it would be feasible to undertake feasibility RCTs with nurses working in Saudi hospitals and to identify any modifications that may be needed before doing so. Three out of five a priori feasibility criteria were met, which suggests the feasibility of the current study in Saudi Arabia. This feasibility study also provided additional important information that informs the design of feasibility RCTs (See Table 31).

Table 30: Summary of Progression Feasibility Criteria

Progression Criteria	The design of the full study is not feasible (Red = Stop)	Modify the study protocol further before conducting a full study without another feasibility assessment (Amber = Amend)	Continue to a full study without amendments in the feasibility study protocol (Green = Proceed)	Findings from this feasibility study	Conclusion of a progression criteria
Recruitment Rate	< 2 participants every week for 12 weeks	2-3 participants recruited every week for 12 weeks. -Consider the representativeness of the sample and possible steps to increase the recruitment. -Find the reasons and barriers for low participations recruitment rates or declining participation. -Potential strategies might include changing or increasing the number of study sites or promoting advertising efforts for recruitment participation.	≥ 4 participants recruited every week for 12 weeks. The total recruited number will be 40-50 participants	4- 5 participants recruited every week. The total number of the recruited participants was 53.	Green = Proceed
Attrition Rate	> 30% of total drop out post intervention.	15%-30% of total dropouts post intervention. - Find possible causes for dropouts and strategies to enhance follow up participation and retention rate.	< 15% - 30% of total dropouts post intervention	8 (15%) participants of total drop out post intervention. 5 (9 %) in the LBP group and 3 (6 %) in the NOLBP group). The attrition rate was higher in LBP group than NOLBP group.	Green = Proceed

Feasibility of Outcome Measures Assessment	> 20% of missing data on the secondary outcome measures. -All of the outcome measures are not sensitive in detecting change.	10% -20% of missing data on the secondary out measures. -Some of the outcome measures are sensitive in detecting change. -Modify the number of outcome measures questionnaires required.	< 20% of missing data on the secondary outcome measures. -All of the outcome measures are sensitive in detecting change.	No missing data was observed (100%), but some of the outcomes were not sensitive to detect change (NRS, FABQ, SF12 & SEE), which need modification to detect change	(Amber = Amend)
Intervention Engagement	< 50% of participants engage with the WBI-BACK intervention programme at least once per week.	50%- 80% of participants engage with the WBI-BACK intervention programme at least once per week. -Find the reasons for non-engagement in order to enhance the engagement in the WBI-BACK intervention programme for the full study. - Identify barriers and facilitators for intervention engagement.	> 80 of participants engage with the WBI-BACK intervention programme at least once.	40 (89 %) of participants in all groups engaged with the WBI-BACK intervention programme. -Participants engage to the WBI-BACK intervention programme in both groups, with more engagement reported in LBP group. - Educational gallery and exercise gallery were the most popular modules among both groups.	Green = Proceed
	< 50% of participants maintain their records of weekly PA in the PA diary sheets.	50%- 80% of participants maintain their records of weekly PA activity in the PA diary sheets. -Identify the reasons why participants do not maintain adequate records for PA and set their goals in the PA diary sheets.	> 80 of participants maintain a record of weekly PA and set their goals in the PA diary sheets	0% of participants in all groups maintained a record of weekly PA and set their goals in the PA diary sheets. -The main reason was a lack of knowledge about the differential of PA and exercise among the nursing population. Additionally, lack of consistency in accessing the WBI-BACK intervention programme, and lack of time.	Red = Stop

Experience of Intervention Components based on the Technology Acceptance Model (TAM)	< 50% of participants rate the perceived ease of use, acceptability and had positive attitude to the use of the WBI-BACK intervention programme as mostly agree and strongly agree scores.	50% - 80% of participants rate the perceived ease of use, usefulness and had positive attitude to the use of the WBI-BACK intervention programme as mostly agree and strongly agree scores. -Make the WBI-BACK intervention programme easier and more acceptable to the participants. -Reduce the complexity of the WBI-BACK intervention programme and re-evaluate it to ensure a suitable level of difficulty.	> 80 % of participants rate the perceived ease of use, usefulness and had positive attitude to the use of the WBI-BACK intervention programme as mostly agree and strongly agree scores.	> 80 % of participants reported that the WBI-BACK intervention programme was easy to use, useful and had positive attitudes and knowledge of the WBI-BACK intervention.	Green = Proceed
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Table 31: Recommendation for Future RCTs

Criteria	Feasibility Criteria Met	Key Suggestions for Future Study
Recruitment Rate	Yes	1- Incorporating advertisements in the social media of the hospital to recruit nurses was a good idea in addition to a face-to-face recruitment strategy. 2- The increased sample sizes will give more power for detecting the change in outcome measures.
Attrition Rate	Yes	1- Reminders from a phone call for follow-up assessment could reduce the drop-outs and should be considered in the future study
Feasibility of Outcome Measures Assessment	No	1- Reduce and review the number of self-administration questionnaires could improve the efficacy of data collection forms. 2- Increase the duration of follow-up (more than six weeks) in a future study to detect clinical change. 3- Future study could include the objective assessment of the knowledge and behavioural change after engagement in the web-based intervention. 4- Future study could include assessment of maintenance of clinical and behavioural outcomes following the end of digital intervention rather than pain intensity measurement. 5- Separate the data analysis of the engagement and non-engagement participants into a digital intervention to provide accurate results. 6- Separate the physical activity questionnaires and other outcome measure questionnaires during the administration.
Intervention Engagement	NO	1- Change in the WBI-BACK intervention program's design to increase and harmonize the utility of the different modules for the primary goals of prevention or for reduction of LBP. 2- Future study should send one module weekly rather than one package to enhance engagement. 3- Future study should focus on the diversity of intervention delivery platforms, such as integrating web-based intervention with applications (apps) could enhance engagement

		4- The WBI-BACK intervention programme could be designed with more interactive features, such as reminders, to enable the users to establish a routine. 5- Future study should assess intervention engagement objectively, including the logins, module views and time spent on each module. 6- Future study should include the training lecture and workshop about physical activity at the beginning of the trial, illustrating a weekly physical activity plan. 7- Future study should explore the barrier and facilitators for nursing engagement in qualitative research in the KSA to inform the future feasibility of RCTs. 8- Future study should involve more stakeholder consultation through the Delphi survey to explore more information into the design and implement a web-based intervention.
Experience of Intervention Components based on the Technology Acceptance Model (TAM)	Yes	1- Separate the data analysis related to the intervention experience of the engagement and non-engagement participants into a digital intervention to provide accurate results. 2- Future study could objectively assess usability and usefulness rather than modified TAM questionnaires.

7.8 Chapter Summary

This is the first study to examine the feasibility and acceptability of the WBI-BACK intervention programme for nursing in the KSA. The current study used progression feasibility success criteria by following a traffic light assessment system: red, amber and green; to evaluate the research process, data collection and intervention procedures. Key criteria for progression to a full-scale trial were met with some modifications to improve intervention engagement. The feasibility trial also provided important information that informed the design and plan of the full trial. The WBI-BACK intervention programme was feasible and acceptable to be delivered as planned into a nursing population working in the Rehabilitation Hospital at KFMC in Riyadh, KSA. The next chapter will discuss the triangulation of quantitative and qualitative results.

Chapter 8: Discussion

8.1 Introduction

This study is the first of its kind to explore the feasibility and acceptability of web-based intervention for nurses working in the Saudi hospitals. More specifically, the prime purpose of this thesis is to explore the feasibility and acceptability of the theory-based WBI-BACK intervention programme, designed for the management and prevention of LBP among the nursing population in the KSA. The secondary aim is to define the likelihood of changes in outcome measures and select the most appropriate outcome measures to examine the delivery of the WBI-BACK intervention programme to nurses with and without LBP for use in a future trial.

8.2 Thesis Overview

An MMR methodology was applied for assessment of the feasibility and acceptability of the WBI-BACK intervention programme. The study was developed based on the MRC guidelines for developing and evaluating complex interventions (Craig et al., 2008). It followed a systematic method (the Agile approach) during the development of the intervention, thereby resulting in the development of a web-based intervention for self-management of LBP in nurses. Overall, 53 participants were recruited from KFMC's Rehabilitation Hospital in Riyadh, KSA, out of which 45 completed the six-week trial. The results indicated that the use of a clinical trial to assess the feasibility and acceptability of the WBI-BACK intervention programme for nurses in the KSA was successful, and the progression to a feasibility RCT was met, owing to the results and recommendations of the current study based on meeting the feasibility criteria.

Generally, the study design was found to be feasible, and the feasibility progression success criteria were met. This chapter focuses on systematically triangulating the findings obtained by

the two methodological approaches (quantitative and qualitative results). The discussion focuses on the theoretical underpinnings of the findings and uses the key feasibility outcomes reported to determine whether and how the WBI-BACK intervention programme was feasible and acceptable among the study participants. The findings are related to the physical, clinical and psychological outcomes of the analysis, with a comparison between pre- and post-participation in the WBI-BACK intervention programme. Caution needs to be exercised when interpreting the exploratory analysis of the clinical outcome measures. This is so because the primary aim of this study was to determine feasibility, and thus, the intent was not to determine intervention effectiveness. At the same time, it is important to understand how nurses perceive the WBI-BACK intervention programme in order to implement this digital intervention successfully into Saudi contexts. Nurses' perceptions are also important to ascertain the barriers and facilitating factors regarding the intervention.

Considering the technological innovations, the acceptability of the technological elements driving the WBI-BACK intervention programme can be explained by referring to the TAM. According to TAM, the propensity of users to adopt a technological innovation is the product of the interplay between the *perceived usefulness* and *perceived ease of use*. However, since the study participants were selected to test the technology, and their choice was not based on the perceived usefulness or perceived ease of use, the findings will be discussed in recognition of this reality.

Furthermore, this chapter outlines the challenges nurses faced in engaging with the WBI-BACK intervention programme in the KSA. Four key determinants of feasibility and acceptability are identified in this study: the usability of the WBI-BACK programme, user perceptions, engagement level and user attitudes. Additionally, the discussion focuses on identifying the relevance of the findings from the perspective of programme applicability within the entire organisation and other similar settings based on the outcomes of the study.

Following on from this, the strengths and limitations of the research are presented along with implications of the trial practice and recommendations for future studies.

8.3 Summary of Thesis Findings

8.3.1 Quantitative Results

The main quantitative analysis included descriptive summary statistics of each of the study progression feasibility criteria (recruitment rate, retention rate, feasibility of outcome measure assessment, intervention adherence and experience of the intervention components based on the TAM). The recruitment rate was successful, and the response rate was 100%. There was an overall decrease in follow-up at post intervention of 15% (9% in the LBP group and 6% in the NOLBP group). Considering main results, it has been found that 89% of all participants engaged at least once per week with the WBI-BACK intervention programme, and more than 80% of nurses reported that the WBI-BACK treatment was easy to use and had knowledge and a positive attitude towards this digital intervention. Additionally, inferential analysis showed that nurses with LBP improved in their level of PA and physical functioning after the WBI-BACK intervention programme, while there were no differences on other secondary measures. Moreover, there was an increase in total PA and PA components (moderate and walking) after nurses' engagement in the WBI-BACK intervention programme.

8.3.2 Qualitative Findings

In order to explore the nurses' experience of the digital intervention, individual semi-structured interviews were conducted with 16 participants from KFMC's Rehabilitation Hospital. The semi-structured interviews provided data related to nurses' perceptions of the usability of the

WBI-BACK programme, their perceptions of potential WBI-BACK usefulness, their engagement with the programme, and their attitudes towards the intervention programme. Most of the nurses were very positive about the usability and usefulness of the WBI-BACK intervention programme in terms of its content, technical characteristics, knowledge enhancement effect and capacity to lead to increases in PA and decreases in LBP symptoms. Overall, the nurses successfully engaged with the WBI-BACK intervention programme; yet individual levels of engagement varied.

In the following sections, these themes are discussed and triangulated with the quantitative results and linked to the TAM theory.

8.4 Principal Findings and Comparison with Previous Work

8.4.1 Programme Usability

Recent studies have used TAM to assess the acceptance of digital intervention as a means of enhancing PA (Drehlich et al., 2020; Hawkins et al., 2019). The usability of the WBI-BACK intervention programme, as a determinant of its feasibility and acceptability, was supported by a range of findings from both the qualitative and quantitative studies. Nurses' perceptions regarding the usability of the programme varied depending on their individual circumstances. First, nursing staff in the LBP group displayed a higher tendency to adopt the intervention programme based on its potential to solve an immediate (tangible) problem they faced from their LBP. The level of awareness and self-management of chronic LBP can vary from one person to another, and this can affect the usability of the web-based programme (Zufferey and Schulz, 2009). In support of this concept, in a previous study, the enthusiastic users of the Oneself programme were ready to accept that they would become active in their LBP

management. Thus, they regularly accessed the web-based programme for support in LBP management (Zufferey and Schulz, 2009).

There is evidence that the ease of use of the digital programme also played a key role in its outcome, as predicted by the TAM (Yang et al., 2019; Davis, 1985). The simplicity of the programme influenced its usability, both in the LBP and NOLBP groups, regardless of nurses' demographic differences, such as their age, gender and background. The programme has a simplified format with categorisation based on the content and purposes of the modules. Second, the design of the programme made the module easy and enjoyable to use, both for the LBP and NOLBP groups. This can be attributed to the fact that the information contained in the intervention programme is easy to understand, as was reported by many participants. The interactive design eliminated the challenges the nursing staff faced in conceptualising the interventions, especially those who did not have prior knowledge about interventions for back pain. Third, the delivery of the WBI-BACK intervention programme did not introduce any complex technical challenges that limited its utility. These results are consistent with a study by Geraghty et al. (2020) who used the SupportBack Internet-based programme on participants with LBP. Most of the participants reported that the SupportBack programme was clear and easy to use, and they valued the simplicity of the design and navigation system, as this supported them in self-management of their back pain. The use of different formats in presenting the content, feature text and audio–visual components, also played an integral part in the usability of the program and ultimately contributed to its feasibility for different users. Specific mention of the audio–visual guides for correct use of the exercises and PA interventions was also made by the participants. These facilitated the personalisation of schedules for use of the intervention, whether for access to knowledge for preventive goals or interventions in the form of exercise. This is consistent with Zufferey and Schulz's (2009) study, who found that the Oneself web-based programme was easy to use, and that the contents

provided in written, photo and video forms helped people with chronic LBP to take advantage of the programme.

The simplicity of the WBI-BACK intervention programme is also indicated by the fact that the information presented therein is linked to particular actions which are directly linked to the SCT for reducing or preventing LBP. As indicated by Keogh et al. (2015), the design influences behaviour-change techniques as predicted under SCT, with specific advantages reported from the credibility of the source of information contained within, the demonstrations of the behavioural change (how to perform the exercises), graded tasks for the various participants, and specific instructions and justifications for the change in the behaviour. Past studies on the usability of the web-based programme to assist in the self-management of LBP have culminated in different conclusions, due to the variables and dimensions investigated, such as the type of intervention and the underlying theory. A relevant example is the study of Irvine et al. (2015b) where SCT and the Theory of Planned Behaviour (TPB) were used to develop a Fitback online programme to help people implement self-management strategies to prevent and manage LBP. The authors revealed a good to excellent rating of the website usability measured by the system usability scale, and significant improvements in behavioural, physical and cognitive outcomes at a 4-month follow-up among the users of the Fitback intervention programme.

It is also apparent that the usability of the intervention programme is influenced by the correlation between knowing what to do, and engaging in the behavioural self-management approaches that lead to reduction or prevention of LBP. Van Erp et al. (2020) and Wippert et al. (2019) posit that online or offline self-management programs provide information on what to do and how to do it. The biopsychosocial approach paves the way for a patient-centred approach to management of LBP among the nursing staff, which further leads to goal-orientation in the adjustment of behaviour of the users. Karppinen et al. (2021) indicated that

the biopsychosocial approach enabled participants to address the social, psychological and biological issues that are associated with LBP, and other outcomes such as disability. The approach was found to be effective for patients with chronic LBP as a physical activity intervention (Van Erp et al., 2019). The biopsychological approach used in the design and implementation of the behavioural self-management web-based intervention programme (see Chapter 3, section 3.5.1) provides multidisciplinary intervention for nurses with and without LBP. This approach lays down the foundation for an LBP intervention based on the characteristics of the patients, and the persistence of disability and pain (Van Erp et al., 2019). However, the usability of the WBI-BACK intervention programme was limited by time-related factors, which explain both the limitations in its feasibility and, to an extent, its acceptability. First, the nursing staff were faced with limitations in access time, since they had professional responsibilities at work. Although there is evidence that some users implemented several techniques in an attempt to remedy this problem such as accessing the intervention programme at home or work, these strategies did not solve the fundamental problem of lack of time. There is an agreement in the literature that lack of time is a barrier to internet users (Hardiker and Grant, 2011). O'Connor et al. (2016) have argued that a busy personal life is a barrier affecting patient enrolment in and use of digital health interventions.

These findings confirmed both the usability of the WBI-BACK intervention programme and limitations in the feasibility of the intervention. The differences in people's characteristics, including age, sex and pain level can influence their behavior towards the usability of the intervention programme at the individual level, and this characteristic could be investigated broadly in future trials.

Figure 20: Summary of Programme Usability

Principal Findings:

- Nurses with LBP displayed higher usability toward the WBI-BACK intervention programme than those without LBP due to increased levels of awareness/the need for self-management of LBP.
- The perceived usability of the WBI-BACK intervention programme was influenced by its simplicity, and the use of different formats in the content as well as the audio–visual components.
- The design of the WBI-BACK intervention programme was influenced by SCT to enhance its usability.
- The correlation between knowing what to do and engaging in the behavioural changes, affects the usability of the WBI-BACK intervention programme, and thus, the extent to which it leads to the reduction or prevention of LBP.
- The usability of the WBI-BACK intervention programme depends on people characteristics such as age, sex, and pain level of LBP.
- The usability of the WBI-BACK intervention programme for nurses was limited by time-related factors.

8.4.2 User Perceptions

The second determinant of feasibility and acceptability relates to perceptions towards the WBI-BACK intervention programme. The SCT posits that behavioural changes aimed at promoting the adoption of self-management behaviours such as those proposed under the WBI-BACK intervention programme, are dependent on the characteristics of the individual, their environment, as well as other dynamics associated with the psychosocial status of the individual (Keogh et al., 2015). Patients' characteristics, including attitude, belief, and culture have had some effect on health management and how patients integrated with their health care providers and environments (Gogovor et al., 2017). To this end, the tendency of the study

participants to adopt the behavioural changes proposed under the intervention programme is based on the perception that such changes will generate positive outcomes. This scenario represents the key difference between the LBP and NOLBP groups, since the objectives and driving force behind the behavioural changes are different: the reduction and prevention of LBP, respectively. The perceptions of the digitization of the intervention are also determined in similarly. Cruz-Benito et al. (2015) stated that the delivery of a clinical intervention through technological interventions influences the perceptions of the participants, thereby influencing the extent to which they accept it, and thus making it feasible.

The views of the participants regarding the potential usefulness of the WBI-BACK intervention programme were based on the expectation of a reduction in LBP among the LBP group, and of the prevention of LBP in the NOLBP group. These perceptions were integral to the uptake of and adherence to the programme. There is evidence of shared perceptions on usefulness, since the participants from the LBP and NOLBP groups appreciated the potential that they could use the knowledge from the intervention programme for the reduction and prevention of LBP among their peers and relatives who were not part of the trial. Interestingly, the NOLBP group viewed the intervention programme as integral to the prevention of the onset of LBP, and they also considered the potential that the knowledge acquired from the programme could be shared with peers and family suffering from LBP. As a result, their motivation for determining the efficacy of the WBI-BACK programme was related to the level of learning.

Despite the differences in the underlying rationale for behavioural change, it is apparent that the participants' knowledge of exercises and other PA increased in general, represented by walking and total PA. The findings reveal that the feasibility of the WBI-BACK intervention programme is dependent on the appreciation of several assumptions that are integrated into the programme, specifically relating to the type and intensity of physical activities that the participants should engage in. However, both the qualitative and quantitative data showed that

there is a need for specification of what types of PA and exercises nurses should undertake to achieve the reduction and prevention of LBP. Ultimately, the increase in PA and exercises on account of utilising the WBI-BACK intervention programme is drawn from the premise that behavioral self-management leads to a reduction in LBP.

The quantitative findings are broadly analogous to the interview findings, showing that the changes in involvement in PA were both qualitative (knowledge of exercise and PA) and quantitative (duration of exercise). These two outcomes are associated with the fact that the WBI-BACK intervention programme was viewed as a reliable guide offering diverse information and directions on what to do, while linking these to objectives for the reduction and prevention of LBP. Previous studies have reported that PA reduces LBP (Alnojeidi et al., 2017), such that an increase in PA was found to deliver positive outcomes for both the LBP and NOLBP groups. In a recent meta-analysis, exercises that strengthen the muscles in combination with other aerobic or stretching exercises were found to reduce the risk of LBP by 30% (Shiri et al., 2018). One previous study has linked sitting time durations with LBP, with the risk of LBP increasing with sitting times over 7 hours/day (Park et al., 2018). Among the NOLBP group, changes in the level of all forms of PA were apparent. Thus, the importance of this study's finding is integral in justifying the usefulness of the WBI-BACK intervention programme for preventive purposes, based on whether the nurses perceived the intervention programme as increasing their knowledge and ability to increase PA.

Self-efficacy is often linked to behavioural change, which is relevant to the current study, since an individual's perception that they can achieve a desired outcome (the reduction or prevention of LBP) will result in the adoption of the proposed PA that they deem suitable. Currently, self-efficacy is becoming increasingly considered in both clinical and research studies (De Moraes Vieira et al., 2014; Woby, Urmston and Watson, 2007). The acceptability of the intervention programme is evident from the increased ability of the participants to engage in productive PA

through improvements in self-efficacy. Among the LBP group, there was an increase in the scores of the self-efficacy for exercise... The increase in PA, as learning a new behaviour, can also be explained by the findings regarding the exercise self-efficacy scale (Chen et al., 2014). The self-efficacy scale for exercise reveals the degree to which participants perceived themselves as being capable of planning and adhering to the regular exercises proposed under the intervention programme in which they face obstacles or a lack of support (Chen et al., 2014). There is evidence of the participants taking direct measures to understand what exercises to perform and how to perform them, as well as engaging in those exercises. These results differ from what the NOLBP group reported, with evidence of an increase in self-efficacy during exercises. An increase in the score reveals that the participants acquired increased confidence in their ability to engage in PA, to prevent LBP. This can also be attributed to the availability of information from the intervention programme that clarified the potential causes of LBP, including the health and lifestyle choices associated with lack of exercise and PA.

The inclusion of knowledge-oriented modules in the WBI-BACK intervention programme accounts for the perceptions of utility in both the LBP and NOLBP groups. Rather than focusing on recruiting individuals to take problem-solving interventions, the programme includes modules that provide information to the users, enable them to understand the problem, as well as the solutions, before actually engaging in them. This explains why participants indicated that they perceived the intervention programme as a key source of knowledge about self-management and autonomous interventions for LBP. The availability of knowledge to facilitate self-management of LBP represents a dimension of feasibility that arises from the utility of solving the challenge without costly and time-consuming interventions (Crowe et al., 2010). Self-management has many advantages in LBP (Fritsch et al., 2021), especially for working individuals, since it can be integrated into the daily lives of the individual, thus leading to limited disruption in their daily schedule and professional engagements.

A close link between mental health outcomes and psychosocial effects is evident from the results, hence confirming the acceptability and feasibility of the intervention programme. Ikemoto et al. (2018) pointed out that interventions aiming to reduce or prevent LBP depend on psychosocial factors, including negative views towards pain, fear-avoidance behaviour, withdrawal/low moods or an expectation of passive interventions that require limited exertion. These also include negative pain schema such as fear, anxiety, and weakness, and how they affect the tendencies of individuals to participate in both work and the physical activities proposed under the intervention programme (Marshall, Schabrun, and Knox, 2017). Furthermore, they include the psychosocial factors that moderate and determine the pain experienced by the LBP group as well as the conceptualisation of what LBP entails by those categorised as NOLBP. The measures to deal with fear-avoidance include graded and gradual exposure to PA and exercises, which aim to achieve two outcomes: relieving fears related to expected pain and adverse views on what the pain represents, and enhancing individual physiological ability that leads to reduced LBP (Marshall et al., 2017).

In short, the positive perceptions about the feasibility and acceptability of the WBI-BACK intervention programme encourage nurses with and without LBP to gain greater knowledge and awareness of self-management strategies for their LBP.

Figure 21: Summary of User Perception

Principal Findings:

- Patients' characteristics such as attitude, belief, and culture had some effect on the user perception towards health management.
- Participants' views regarding the usefulness of the WBI-BACK intervention programme were based on the expectation of a reduction in LBP among the LBP group, and the prevention of LBP in the NOLBP group.
- Perceptions toward the WBI-BACK intervention programme led to increased participant knowledge of self-management of LBP (especially exercises and PA).
- The increase in PA level of WBI-BACK users can be attributed to many features offered by the intervention programme.
- There is a link between mental health outcomes and psychosocial effects, which confirms the acceptability and feasibility of the intervention programme.

8.4.3 Engagement Level

The level of engagement with the WBI-BACK intervention programme as a determinant of its feasibility and acceptability is evident, such as in the development of, and change in behavioural and educational strategies for the self-management of LBP. Fritsch et al. (2021), Nicholl et al. (2017) and Svendsen et al. (2020) have revealed that the level of engagement with a programme indicates its acceptability. The acceptability of the WBI-BACK intervention programme was thus determined by the level of engagement among the nursing staff. According to the TAM, users were predisposed to increase the degree of use based on whether they perceived the WBI-BACK intervention programme as being useful for their needs. As a result, the level of engagement identified in the results was dependent on the extent to which the participants in the LBP and NOLBP groups sought to achieve reduction and prevention of LBP through the programme. Ryan, Edney and Maher (2017) assessed user engagement with an online application for PA intervention. The authors found that engagement differed based

on sociodemographic characteristics, including education, gender, and age, with the strongest engagement coming from the higher-education category and of the male gender. In the sample for this current study, all of the participants were qualified as nursing professionals. This means that they were in the higher-education category, as reflected in their high levels of engagement with the WBI-BACK programme.

The level of engagement is evident based on the modules that the study participants from the two groups focused on. There were differences in the modules that the participants from the LBP and NOLBP groups accessed, and these were dependent on personal choices. Such preferences also account for the general variation in frequency of access to the intervention programme. Specifically, there was a preference for the educational and exercise modules among the nursing staff with and without LBP. The preference for the education module, which is analogous with the perceived usefulness under TAM, is attributed to the fact that it is first in the intervention programme and offers information about LBP. This is connected to the lack of time to access the entire intervention programme, which was discussed previously in Chapter 6, section 6.6.3.1

There were also variations in the points of access, which were determined by the availability of time at the workplace or home, and access to online services. Exposure to web-based intervention content has been directly associated with intervention effectiveness for LBP, with increased exposure leading to higher effectiveness (Steele, Mummery and Dwyer, 2007; McKay et al., 2001). This is explained by the view that the nursing staff took pertaining to acquisition of knowledge regarding their LBP, and the importance of exercises, as well as how to perform the exercises from the exercise modules. Accordingly, the preference for the educational, exercise, and PA modules arose from their complementary and supplementary nature. This is consistent with previous literature showing that the level of engagement

decreases based on the frequency of the login step, while the behaviour itself remains stable (Ryan et al., 2017).

The utility of the educational, exercise, and PA modules is demonstrated by the fact that both the LBP and NOLBP groups found them useful for several reasons. First, there is a close link between exercise and LBP management, whereby the nurses desired to learn physical activity and exercise guidelines to manage and prevent their LBP. Second, the gain-framed messages, which were presented in audio and audio-visual format in photos and videos, offered different options to users to stimulate engagement. Similarly, since they are situated at the start of the programme, they tended to be the primary point of contact for the user every time they visited the intervention programme. Third, motivation to do exercise was cited by some participants to decrease their LBP, and this was identified as a key determinant of the SCT.

Furthermore, other subsequent modules such as ergonomics and the psychological units included propositions designed to offer advice and recommendations, rather than guidance for the exercise activities that the participants had to do repeatedly. The limited engagement with the psychology module can be attributed to the fact that the information is framed as consisting of well-being activities rather than psychological ones, which needs to be considered when designing a digital intervention for professionals or patients. Therefore, the engagement level in the WBI-BACK intervention programme decreased over time, which is consistent with the study of Drehlich et al. (2020). Identifying strategies to promote engagement in the web-based intervention may be important for future digital interventions. It should be noted that in this feasibility study, the WBI-BACK intervention programme was delivered as a single package during the initial meeting, and the participants had access to the intervention for six weeks. It would be more beneficial to deliver the intervention weekly, and one module at a time, to ensure that all participants were engaged throughout each module. Future trials could consider this during implementation.

The results of this study are also supported by previous literature demonstrating the relationship between programme features and user engagement. Online programme features that include gamification and the use of notifications tend to increase engagement levels (Deterding et al., 2011). Gamification refers to the inclusion of interactive games, feedback and goal setting (Deterding et al., 2011). Based on main results, these features (interactive games and notifications) were found to enhance the level of engagement in the WBI-BACK intervention programme. Similarly, push notification reminders, such as emails or text messages, are also considered to promote the uptake of digital behavioural interventions (Neff and Fry, 2009). With regard to online health behavioral promotion, consular and peer support, and telephone/email contact improve participant engagement (Brouwer et al., 2011). However, some of the participants highlighted that engagement in this intervention through email was time-consuming, and that it would have been easier to engage directly through an application intervention programme on their smartphone. Such an application could send daily notifications to access the programme and help participants determine their weekly goals. At the same time, the results of this study clearly indicate that the weekly reminder emails were useful and increased levels of engagement. This is consistent with other studies showing that weekly push emails increase user engagement with online intervention, as indicated by weekly peaks in application usage (Ryan et al., 2017; Thrul, Klein and Ramo, 2015). While many online digital interventions include notifications delivered through SMS, email and mobile phones, little is known about their effectiveness and how their timing, content and frequency affect engagement (Ryan et al., 2017). Therefore, it would be better for a large trial to incorporate a weekly reminder notification to regularly pull the users back to the online interventions. Future trials manipulating the notification parameters (e.g., application) are recommended.

Figure 22: Summary of Engagement Level

Principal Findings:

- The acceptability of the WBI-BACK intervention programme was determined by the level of engagement among the nursing staff.
- There were variations in the popularity of the modules, with participants showing interest in accessing all modules, but mostly the first and second modules (educational and exercise modules) and less frequently the latter modules (ergonomics, psychological unit and health lifestyles).
- There is a relationship between programme features (gamification and the use of notifications) and user engagement.
- There is a need for specification of what types of PA and exercises the nurses should undertake to achieve the desired outcomes in terms of reduction and prevention of LBP.
- Identifying strategies to promote engagement in the web-based intervention may be important for future digital interventions.
- The audio-visual format in photos and videos offered the different users appropriate stimuli for engagement.
- Objective data is recommended when collecting engagement levels data.

8.4.4 User Attitudes

Participants' attitudes were found to influence acceptability, thereby determining the feasibility of the programme. Previous studies have pointed towards the prominence of attitudes as key determinants of behavioural change, which is also predicted under the SCT (Ghadyani et al., 2016; Keogh et al., 2015). As shown in the current study, the attitude of the participants toward the WBI-BACK intervention programme influenced the decision to participate in the programme, as well as provide feedback, which was integral in determining the changes between the baseline and post-test scores.

Overall, the attitudes of the nursing staff regarding the interventions were positive. Among those who had positive attitudes, the ease of use of the programme was an important factor.

Drawn from both the LBP and NOLBP groups, the positive attitudes regarding the ease of use are further explained by the fact that the nurses saw the programme as being easy to integrate into their daily lives, with limited disruptions. However, the slight increase in fear-avoidance behavior, both for work and PA, found within the LBP group, can be attributed to the concerns that an increase in LBP intensity is attributable to the interventions proposed under the SCT. There is also evidence that the participants could prevent the worsening of LBP by being capable of identifying the fundamental causes and aggravators of LBP. This influenced participants' attitudes, who indicated that over time, they realised the benefits of the intervention programme.

The changes in fear-avoidance behaviour towards work-related activities can be attributed to the fact that the participants are able to avoid work-related activities that cause or worsen LBP. Such actions include incorrect lifting techniques, standing or sitting for too long, and working for too long without taking a break, among others. Consistent with the results in this study, one previous study showed that patients with chronic LBP had significantly higher FABQ scores than patients with acute LBP, and these differences remained unchanged over one year (Grotle, Vøllestad and Brox, 2006). Importantly, another study performed on nurses with LBP revealed a high FABQ score regarding PA, and these were 1.8 times more likely to have chronic LBP, even after adjusting for work hours, night shift work and psychological distress (Fujii et al., 2019). This may be reflected in the high FABQ and NRS scores after the WBI-BACK intervention programme.

The other possible reasons for increased fear avoidance belief scores could be related to the cognitive behavioural fear avoidance model (Vlaeyen and Linton, 2000). A study conducted by Linden, Scherbe, and Cicholas (2014) suggested a cognitive behavioural approach upon performing weekly PA to reduce fear of movement. According to this model, patients with chronic LBP can exhibit two approaches to activities: a persistence in the activities or

avoidance, characterised by a low activity level (Hasenbring, Hallner and Klasen, 2001; Hasenbring and Verbunt, 2010). Whereas persisters tend to continue their daily activities until they reach their intended goal/completion despite pain. On the contrary, avoiders try to escape from activities that they expect will increase injury or pain. Nevertheless, after the completion of activities, pain might increase, which forces persisters to rest until the pain subsides (Huijnen et al., 2011; Birkholtz, Aylwin and Harman, 2004).

In this current feasibility study, nurses were asked to report the average of their back pain intensity over the last week pre-WBI-BACK intervention and six weeks post- the intervention. As the nature of chronic LBP fluctuates rather than being static, this could explain the increased NRS scores post-intervention. More precisely, the internal scale that patients use to rate their pain can be changed over time (Hush et al., 2010). Hush et al. (2010) argued that the NRS scores on one day could not reflect the general picture of the pain in patients with LBP. Individuals tend to incorporate cognitive evaluation characteristics into their assessment of their pain intensity (Hush et al., 2010). Thus, the time frame of pain intensity assessment was an issue for the NRS tools. Alternative instrument tools would be recommended for nurses with LBP. Nevertheless, the current study indicates the type of LBP that the participants experienced based on clinical definitions by Koes et al. (2010). Accordingly, it was apparent whether the individuals in the LBP group experienced either sub-chronic (at least 6 weeks, which was the duration of the entire study) or chronic (more than 12 weeks) LBP.

Furthermore, engagement levels were found to be minimal in terms of the intervention frequency required to produce a substantial effect (once per week). These outcomes can also be attributed to the failure of the study participants to adhere to the standard level of MET PA recommended by the American Heart Association (Piercy et al., 2018). By exceeding the recommended standards for some forms of PA while failing to achieve the minimums for other types of PA, the study participants were prone to experience undesired outcomes. Although

fear avoidance beliefs were increased after engaging in the intervention programme, this could be attributed to the cognitive behavioural fear avoidance model for patients with LBP. Thus, nurses with LBP required support due to their negative perception of LBP, and psychological intervention to improve their PA level.

The positive attitudes are also evident from the fact that ease of use is complemented by the suitability of knowledge in the prevention and reduction of LBP through PA and exercise (see Chapter 6, Theme 4, section 6.6.4). The availability of information, as well as directions on what to do, enabled the nurses to understand the problem and select the solution that best fitted their situation.

The attitudes of the participants are also appreciated from the perspective of the identification of barriers (see Chapter 6, Theme 3, section 6.6.3.3), and the measures to overcome these limitations to optimal results. The barriers identified in the current study are the fundamental causes for the low uptake or failure to engage to the intervention programme. Although the intervention programme is viewed as usable based on the usefulness of the digital delivery mechanisms, there are some challenges associated with accessing this intervention programme. These barriers may partly explain the rationale for why participants did not attain improvement under some of the outcome measures. As indicated by Geraghty et al. (2018), most technological innovations are plagued with challenges, but most of them are unexpected.

In the case of the WBI-BACK intervention programme, the most evident barriers, including lack of sufficient time, were apparent from the start. The predictability of this barrier is further evidenced by the fact that the participants utilised the modules to varying degrees, with very few having completed the intervention programme by the end of the intervention period (6 weeks), while others picked and chose modules based on convenience. The lack of time limited the willingness of the participants to commit to accessing the intervention programme, since workplace breaks were not sufficient for its meaningful use. Similarly, the lack of time explains

why certain technological challenges, such as lack of access to Internet connectivity, were relevant. Furthermore, the lack of time explains why some modules such as the educational and exercise modules, were more popular. Modules focused on undertaking certain activities such as exercise and physical activity could be performed within the hospital, due to lack of the necessary equipment and materials. As a result, the theoretical dimensions of the intervention programme appear to have been the primary focus of the participants, who faced challenges in practising what they learned. To enhance feasibility, the intervention programme should be adjusted in recognition of these challenges associated with time, e.g., by reducing the size of the modules.

Based on these findings, the feasibility and acceptability of the WBI-BACK intervention programme can be attributed to the combined outcomes of the principles of the TAM and SCT. The feasibility of the intervention programme is linked to the usefulness of the model in the prevention and reduction of LBP among the two groups, as well as third parties, including peers at work, and relatives and friends at home. The acceptability of the intervention programme is influenced by the ease of use and is determined by the perceptions that accessing the programme and following the proposed activities does not result in adverse effects for the nurses.

Figure 23: Summary of User Attitudes

Principal Findings:

- Overall, the attitudes of the nursing staff regarding the WBI-BACK intervention programme were positive.
- Negative views from some nurses could be from the catastrophizing of LBP, based on the belief or perception that an increase in physical activity and exercises led to the worsening of the condition.
- The attitudes of the participants are appreciated from the perspective of the identification of barriers towards engagement in the WBI-BACK intervention programme.
- Positive attitudes toward the intervention programme are linked to the perceptions by the nurses that the intervention programme is suitable for their situation.

8.5 Feasibility and Acceptability of the WBI-BACK Programme for Self-management of LBP among Nurses

The feasibility and acceptability of the WBI-BACK intervention programme for the self-management of LBP among nurses were determined based on several outcomes associated with the study. As shown above, the usability of the intervention programme made it feasible and acceptable for the purposes of both prevention and reduction of LBP. The perceptions of the participants provided further evidence of its utility for these two goals. However, the level of engagement reveals a disparity in the feasibility and acceptability for the intervention programme. Additional indicators regarding the feasibility and acceptability of the intervention programme were determined from the activities linked to the design and processes of the study. The following section will discuss the feasibility of the research process and data collection.

8.5.1 Recruitment and Response Rate

Eighty nurses with and without LBP were approached from KFMC's Rehabilitation Hospital, and only 62 (77.5 %) agreed to participate in this study. Fifty-three (66.2%) participants were found to be eligible after the inclusion and exclusion criteria were applied. The current research successfully reached a sufficient level of enrolment of the participants in an efficient and timely manner. The average recruitment rate was three participants per day in the first two weeks, which decreased to one participant during the other 10 weeks. The differences in the recruitment and response rate between the LBP and NOLBP groups reveals an overriding assumption that the WBI-BACK intervention programme is more suited for nurses with LBP, rather than the possibility of offering preventive options for all staff nurses. Similarly, it is also indicative of the willingness of those suffering from LBP to try this option, as a way of alleviating their suffering. Previous studies have described the differences in recruitment rates, with Newington and Metcalfe (2014) attributing outcomes to the altruistic nature of such experiments. Additional considerations and determinants include the logistical challenges and providing motivation for those willing but unable to participate.

The recruitment rate was faster than that expected, which was due to the direct (face-to-face) recruitment strategy and the support provided by the head nurse in the Rehabilitation Hospital. Potential participants were attracted by the face-to-face recruitment strategy in the wards, as it was considered a more respectable and effective approach in Saudi Arabian culture (Alabdulbaqi, 2019). Participants were informed of the study by the PR, where she explained the research details and full study protocol. The PR explained the perceived usefulness of the WBI-BACK intervention programme for prevention and reduction of LBP and ensured to answer questions related to their role of participation in this study. In a study by Geraghty et al. (2018), 14–15 patients with LBP were recruited each month over 6 months, through a face-

to-face strategy from their GP in the UK. Nonetheless, Noblet et al. (2019) recruited only 10 participants per month from rural and regional primary care in the UK through convenience sampling and a fluid recruitment strategy. The difference in the recruitment rates may be due to different populations within these studies, as this study recruited nurses rather than patients with LBP, as well as the different settings, as KFMC's Rehabilitation Hospital is considered a tertiary hospital rather than a primary one.

A number of strategies for ensuring optimal recruitment success, and ultimately research performance are proposed for trials designed for promotion of health outcomes. Joseph, Keller and Ainsworth, (2016) advised researchers to utilise existing social networks, develop materials for recruitment, target potential study participants across different venues, establish a robust basis for trust, respect and rapport, and collaborate with gatekeepers and influencers. Based on the experiences from the study, recruitment took longer in the early morning at the start of the shift. The process also took longer on the first (Sunday) and last (Thursday) days of the week. Conversely, the recruitment time per study participant was shorter for those recruited during midday hours, as well as days during the middle of the week. There were also variations in the average rate of recruitment across the 12 weeks over which the entire recruitment was conducted, with a high rate of three participants per week for the first two weeks, which decreased to one participant per week for the remaining ten weeks. The gradual reduction in the number of study participants recruited is a normality, which can only be solved through extensive prior planning.

Effective recruitment is an important component for the research success after recognising the target population. The recruitment strategy appears to have been appropriate in this study. It is noted that the healthcare provider accelerated the process of recruitment and motivated them to be included in the study (Bower et al., 2014). Participants were asked to complete the

baseline questionnaires; of the 53 participants (35 in LBP and 18 in NOLBP groups) who completed forms, 100% completed the online questionnaires. Previous studies indicated that online survey approaches improve response rates and improve the quality of data (Cook et al., 2016). This high response rate could be related to the face-to-face recruitment strategy, when compared with previous studies (Haider et al., 2019).

However, for the participants recruited through the face-to-face strategy by the researcher, there was a high possibility of selective recruitment, while the study was also advertised on the meeting boards for each ward. In this study, the traditional recruitment method by posting flyers did not yield any interest from the nurses. Page et al. (2011) agreed that the use of advertisements in patient waiting rooms to reduce the risk of selection bias during recruitment was not successful. The completion of an adequately powerful study would be useful using alternate strategies to reduce the risk of bias, such as a passive selection strategy or recruitment by other staff (and not a researcher). No previous study has recruited nurses with and without LBP for a digital web-based intervention.

The sample size was reasonable for this feasibility trial, in accordance with similar previous feasibility studies (Geraghty et al., 2018). The sample size was also adequate in terms of addressing the study aim and objectives in accordance with the NIHR NETSCC glossary (NHS, 2016). Although the data was limited and represented only one hospital in the KFMC, nevertheless, it revealed that nurses had high levels of interest in the study and were willing to participate. At the same time, it is possible that including a large number of nurses from a different setting could alter the data resulting from this feasibility study.

8.5.2 Eligibility Criteria

The criteria adopted for the study was selected to ensure the inclusion of participants who were sufficiently representative of all sub-categories of individuals who work in the hospital, and those who face the risks associated with LBP. The study participants were drawn from the KFMC hospital, comprised of male and female employees, who spoke English, and could access the WBI-Back program. Female employees who were pregnant, as well as male or female employees with contraindications from unsupervised physical activities, were excluded. This is because the LBP experienced by such individuals is not always chronic. Similarly, individuals who lacked the technical ability to use the digital intervention programme were excluded. For the quantitative study, a total of 45 (30 LBP and 15 NOLBP) participants were selected from the original 62 participants. For the qualitative study, a total of 16 participants (12 LBP and 4 NOLBP) were involved in the study. The diversity in the study participants, based on demographic and psychographic characteristics, played a key role in testing the feasibility and acceptability of the programme among individuals with different characteristics within the hospital.

However, there were no specific measures to consider the effects of the variations in the ages of the study participants on the incidence of LBP, the ability to adjust behaviours, and the responsiveness to the interventions under the intervention programme. Increase in age predisposes individuals to LBP, while also limiting the effectiveness of certain interventions (Martorella et al., 2017). Several studies have found that age is a moderator of the efficacy of interventions for LBP. From a set of four randomised trials involving 7208 participants, Gurung et al. (2015) found that age was one of the statistically significant moderators of responsiveness to LBP. The current study relied on data from participants who were all under the age 50 (this is the most common working age range for nurses in KSA), and this was

informed by previous literature that digital intervention was not successful in older patients (over the age of 55; (Ben-Ami et al., 2017). Therefore, the efficacy of the WBI-BACK intervention programme for persons of different ages is indicative of its feasibility, since it can be more effective in younger populations. Furthermore, through the representation of all age groups, findings help to underpin the fulfilment of the requirements for clinical governance, whereby decisions are supported by evidence.

8.5.3 Follow-up Procedures and Retention and Attrition Rates

Of 53 participants who consented to participate in the study, 45 participants (30 LBP and 15 NOLBP) were retained for follow-up at 6 weeks. The attrition rate in this feasibility trial was $n = 8$ (15%), which was acceptable based on the research methodology literature and met the feasibility criteria (Zelle et al., 2013; Fewtrell et al., 2008). The 85% retention rate can be attributed to the perception that the intervention programme was feasible and acceptable for the intended purpose. Previous literature has linked the use of both recruitment and follow-up strategies to enhanced retention rate (Zelle et al., 2013; Fewtrell et al., 2008). This enhancement can be attributed to sustained regular contact with participants during recruitment into the trial. In designing a full trial, it is important to involve a strategy that improves retention. Previous studies have proposed that at least three communication channels such as text, email and telephone, should be provided for each participant (Noblet et al., 2019). Most of the retention strategies were addressed in this study during the follow-up such as weekly reminder emails and online communication between the PR and the participants by email. It is possible that those strategies boosted retention rates.

Finally, the attrition rate did not significantly affect the amount of data required for meaningful analysis through the selected analytical methods. These findings point towards the feasibility

and acceptability of the WBI-BACK intervention programme among nurses with and without LBP.

8.5.4 Delivery of the Intervention

The delivery of the intervention through digital means influenced adherence by the participants as well as the attrition rates. The WBI-BACK intervention programme was delivered successfully as proposed in this study. Because the intervention programme was digitised, the participants had to log on and undertake their exercises and physical activity. Similarly, the proposed PA required time and space, meaning that although the intervention programme was advertised as a web-based intervention, it required a multiplicity of offline activities that had to be considered to achieve the targeted level of feasibility and acceptability. The facilitators and barriers for the WBI-BACK intervention programme were discussed previously in Chapter 6, Theme 3, section 6.6.3.

Emergent and extant research concurs that web based interventions (WBIs) present additional benefits that translate to efficacy in the reduction and prevention of LBP and related comorbidities in comparison to offline alternatives. Sandal et al. (2019) indicated that the selfBack application supported the customised self-management approach for LBP, while Sander et al. (2017) found it to be a cost-effective approach. The technological alternatives related to WBIs enable medical staff to provide remote contact for follow-up, especially when face-to-face consultation is not possible (Martínez-Mesa, 2016). The current WBI-BACK intervention programme integrates a multiplicity of clinical guidelines required for non-pharmacological interventions for LBP, including application of the biopsychosocial approach. The programme provides information and knowledge to the participants, while also guiding them through the process of customising the intervention to fit their dynamic needs.

Emergent and extant research agrees on the fact that the WBI-BACK intervention programme presents additional benefits that translate to efficacy in the reduction and prevention of LBP in comparison to offline alternatives.

The utility of digital content is dependent on the ‘tech-savviness’ of the users, a factor identified in the study by Sander et al. (2020), and which is relevant for web-based interventions. The digital option led to achievement of the delivery-oriented objectives but based on the barriers identified from the study such as lack of time and lack of access to the Internet, it also created several limitations. These limitations have been identified by Beall et al. (2014), who argued that an over-reliance on one mode of delivery presents several challenges, since it limits the options available to users. Their study’s proposes the integration of multiple delivery modes to enhance the feasibility and acceptability of the intervention programme.

The WBI-BACK intervention programme was delivered as a single package during the initial meeting, and the participants had access to the intervention for six weeks. The digital intervention delivery in this feasibility study was similar to that in the study performed by Geraghty et al. (2018), which focused on supporting patients in the self-management of LBP. Their results show the feasibility of a future trial to determine the cost-effectiveness and clinical outcomes of the SupportBack programme.

8.5.5 Intervention Engagement

The extent to which the participants engage to the WBI-BACK intervention programme is partly explained by the *perceived ease of use*, *perceived usefulness*, engagement level and user attitudes, all of which was covered in earlier sections of this chapter. Under TAM, engagement to the intervention programme is analogous to the intention to use. On one hand, the participants reported variations in the modules they accessed, with the variations related to how the modules were utilised for the intended purpose. The *perceived ease of use* was influenced

by the complexity of the programme, the technical challenges in accessing the content (such as lack of Internet connectivity), the language barriers, and lack of sufficient time to cover all the content within each particular module, as well as the entire intervention programme. On the other hand, *perceived usefulness* was determined by the differences in response rate between the LPB and the NOLBP group. Under this dimension, the expectations of preventing LBP were universal, while the possibility of reducing LBP was more commonly a determinant among the LBP group.

Engagement to the WBI-BACK intervention programme was considered as accessed to the intervention programme at least once per week over six weeks, and maintenance of a diary of PA sheet weekly. Although a large number of the participants engaged in the intervention programme for the targeted duration, none of them kept their weekly physical activity diary sheets and set their goals. Based on the reported statistics, it is apparent that the largest proportion of the participants achieved low-frequency adherence by accessing the programme only once per week. The reasons for this outcome included lack of time, technical challenges due to Internet connection and decreased motivation. These variations in engagement with the intervention are the most common problems for online interventions generally. The level of engagement was discussed previously in Section 8.4.3.

Goal setting is a continuous process of evaluating a goal rather than making a fixed decision (Weinberg, 2002). In line with this, previous findings have shown that the promotion of PA is made significantly more effective when digital interventions assign PA goals over time rather than static ones (Adams et al., 2017). This is an encouraging finding, suggesting that digital interventions that add goal setting add the benefit of greater individual improvement (Fanning, Mullen and Mcauley, 2012). Although PA sheets were given to the participants to set their weekly goals regarding PA levels, none of the participants, in either the LBP or NOLBP groups, maintained records of their goals. The absence of a goal-setting strategy could explain

why the participants did not record weekly goals for their physical activity. Further, results from SR and meta-analysis revealed that goal setting interventions are most effective when goals are set for daily PA, or a combination of daily and weekly PA (McEwan et al., 2016). In the present study, the goals were set in relation to weekly PA, therefore, it can be deduced that adjusting goal setting in relation to daily and weekly PA is effective for improving PA behaviour. The absence of a community forum in the WBI-BACK intervention programme was another important factor that hampered communication between the participants and the researcher, as the participants did not receive tailored feedback on their PA goals. This could also explain why none of the participants filled out their weekly goal-setting sheets. Previous research has found that interventions are effective when the participants are provided with feedback on their goals or receive rewards for their progress (McEwan et al., 2016). This is probably because individuals are more likely to stay motivated and become more confident if goals are re-evaluated and adjusted for treatment achievement (Baretta et al., 2019). These results offer a number of principal insights in goal-setting strategies for designing a future trial that promotes PA among the nursing population working in Saudi hospitals.

The low engagement can be attributed to several reasons, which are evident from both the quantitative and qualitative data. First, the nursing staff had limited free time to access the intervention programme, due to their professional commitments. Second, the study participants faced challenges in accessing the digital content, due to lack of, or poor Internet connections. The inability to consistently utilise the contents of the WBI-BACK intervention programme evidently contributed to the inability of some of the participants to build upon and progress in the knowledge associated with increased PA, and is part of the reason for low efficacy, and ultimately a decrease in feasibility. These changes are integral in providing the participants with current and up-to-date information, as well as improvements to the design of the intervention programme to enhance engagement.

8.5.6 Experience of the Intervention

The findings reveal that the intervention programme provides the criteria set for primary and secondary results for both groups (the LBP and NOLBP groups), thereby justifying the widespread adoption. Although the primary goal was to determine the feasibility of the WBI-BACK intervention programme, additional benefits are observed as predicted by Sandal et al. (2019) including the ability to self-monitor, and the education of the patients with LBP. A number of the participants revealed that the intervention gave them an opportunity to undertake exercises and PA and to situate the daily challenges facing peer employees (and friends/family) who face the debilitating effects of LBP.

Failure to achieve optimal results is not necessarily indicative of problems with feasibility, since past experimental studies such as Riva et al. (2014) have only achieved above-average success. The short follow-up period is also a factor of concern, since behavioural changes capable of stimulating adjustments in quality of life take much longer. The studies reviewed in the various systematic reviews have varying durations, with Riva et al. (2014) assessing the effects after 2 months, while Pozo-Cruz et al. (2013) used a 9-month period. Sander et al. (2020), who targeted a 12-month period, reported additional benefits over and above the low-threshold therapeutic routines that only target LBP. Their studies achieved additional therapeutic outcomes. These findings indicate the possibility of enhancing and amplifying the feasibility of the WBI-BACK intervention programme by targeting longer durations. By lengthening the period of use, the users get multiple opportunities for engaging with the intervention programme and benefiting from the proposed interventions.

Of those who participated in the study, there is direct and indirect evidence of the development of a sense of common accountability towards determining and proving whether the WBI-BACK intervention programme is feasible and acceptable, as a solution to a problem that faces

some of the nursing staff. The participants reported some suggestions for improvement, most of which were linked to the potential for increased adherence to and engagement with the intervention programme, especially among the interviewees (see Chapter 6, Theme 3, section 6.6.3.4).

However, the nurses seemed not to engage fully with the WBI-BACK intervention programme, so the digital intervention may not have played a key role in their outcomes. Essentially, even though most of the nurses accessed and used the intervention programme, they may not have actually engaged in the targeted behavioural adjustments that were necessary for changes in biopsychosocial status. The gap in engagement reveals the possibility that whereas the study participants recognised the benefits of engaging in the programme, they only achieved suboptimal utilisation of the knowledge available, leading to suboptimal change in behaviours, as well as engagement in the proposed exercises.

8.5.7 Data Collection Methods and Outcome Measures

The variety of data collection methods and outcome measures applied in this study focused on the various dimensions of the impacts of the WBI-BACK intervention programme including the physical and psychological outcomes. The use of different outcome measures was necessary to measure responsiveness, which can be determined by relevant changes over a defined period and based on a definite type of intervention. The selection of the outcome measures tool in this study was based on previous literature using a core outcome set to assess non-specific LBP including pain intensity, physical function and health-related quality of life (Chiarotto et al., 2015). The standardised tools were also tested for reliability and internal consistency in the previous literature. These results will be interpreted with caution, as this feasibility study and the effectiveness of treatment are beyond the scope of this study. The feasibility study is not necessarily about detecting meaningful change, but to inform as to what

outcome measures might be useful regarding ease of use and response rate to the outcome measures after the WBI-BACK intervention. Judgement on the quality of outcome measurement tools requires the assessment of the evidence about their measurement properties in the defined population (Prinsen et al., 2016).

Overall, 100% data completeness from the outcomes was achieved in this trial by using a Jisc online survey at the baseline and 6 weeks after the intervention. Data collection through an online survey was feasible and accepted by both the researcher and participants, supporting previous studies that reveal better response times with less missing responses when using online questionnaires (Lonsdale, Hodge and Rose, 2006; Denscombe, 2009; Noblet et al., 2019).

Importantly, this study relied on several multi-item outcome measurement instruments. These items tested different dimensions of the effects of LBP, thereby establishing the key problem facing the study participants. Additionally, these measures tested the different dimensions of change in the effects of LBP, matched with the appropriate interventions undertaken by the individuals while taking into account whether or not they suffered from LBP. These measures provide a comprehensive and multifaceted snapshot of the problem and the changes due to interventions. However, the outcome measures utilised here only assess the baseline and post-test scores, with the assumption that the interventions adopted by the participants were either balanced during the period, or progressive. However, there is no indication that the participants achieved such outcomes, since it is possible that some participants achieved an increase in the level of participation during the entire period, while others faced fluctuations in their levels of participation during different phases of the study. Failure to integrate these dynamics limits the ability of the researcher to determine the actual effect of the differences in the baseline and post-test scores. The inability to identify the possibility of a cancelling-out effect in the

outcomes of the study limits the effectiveness of the trial process, as well as the entire intervention programme.

The data collection tools rely on a Likert scale, which eases the process of self-assessment. Despite the differences in the scales used, as well as the possibility of lack of standardisation in the assessment of outcomes, these tools have displayed empirical utility in assessing change over time. As a result, they provide evidence of the feasibility and acceptability of the intervention programme across a multiplicity of dimensions. However, the reliability does not nullify the possibility of ceiling effects of the various measures. In experimental studies, ceiling effects occur when a significant proportion of the participants score highly for the reported variables (Gulledge et al., 2019). Conversely, floor effects occur when a high number of the participants report low scores. These two categories of scale decrease effects, which limits the extent to which an independent variable influences the change on the dependent variable. Odonkor et al. (2021), Tishelman et al. (2019) and Costa et al. (2008) recognised both ceiling and floor effects as key determinants of the actual and/or perceived efficacy of a self-management intervention. Odonkor, et al. (2021) pointed out that ceiling effects are determined by cognitive and behavioural characteristics which are also found to be influential in the adoption of the behavioural changes integral to the interventions targeted for LBP. In these studies, ceiling effects are attributed to response bias constraints, whereby participants provided high baseline scores, which can occur due to a number of reasons, including the tendency catastrophize pain (Ramasamy et al., 2017). Similarly, ceiling effects occur due to the propensity of participants to understate and overstate the severity of the effects of LBP, since the pain scales are inherently subjective rather than objective (Gulledge et al., 2019). The role of ceiling effects is magnified by the shortness of the duration of the experiment, since the participants did not necessarily get enough time to use the WBI-BACK intervention programme for certain effects.

8.6 Study Strengths and Limitations

8.6.1 Strengths of the Study

This feasibility study is the first in this research area undertaken on a nursing population using a theory-based online intervention for the self-management of LBP. In addition, it helps to explicate how the intervention brings about change. The use of theory-based intervention has many advantages such as in planning the intervention, designing a framework that predicts and interprets behaviour and elaborating on how the intervention brings about change (Rutten et al., 2014; Irvine et al., 2015a).

The second main strength of this study was its use of theoretical framework (SCT and TAM) in the design and implementation of the WBI-BACK intervention programme, in addition to stakeholder consultation, which allows for the nurses to provide the maximum possible contribution. Accordingly, their preferences were reflected in the design and evaluation of the WBI-BACK intervention programme. Additionally, the engagement of other healthcare specialists, including physiotherapists, health educators and psychologists, ensured expert knowledge was included in the design of the digital intervention. Indeed, it has previously been suggested that stakeholder consultation should play a major role in the design and planning of study elements and consequent feasibility studies (Green, 2016, Kebbe et al., 2017).

This feasibility study employed a robust study design including a mixed-method approach that combined quantitative and qualitative components and, as such, overcomes some of the inherent weaknesses linked to each of these research approaches when used individually. It used a process evaluation at multiple time points, including analysis and synthesis of the results, to determine the feasibility and acceptability of the WBI-BACK intervention

programme among a nursing population in the KSA. The study had no adverse effects on the participants of the intervention.

A further strength of the feasibility study was the exceptionally high response rate from the nurses, both with and without LBP (100%). It is argued that a response rate of at least 60% should be obtained in questionnaires to avoid non-response bias (Fincham, 2008).

8.6.2 Limitations of the Study

Although the study had a number of strong points, there are several limitations that need to be considered when analysing and interpreting its results.

8.6.2.1 Sample size

The study used a small sample size and was thus underpowered ($n = 45$). It is likely that the use of a small sample size in the study may have led to greater sampling variation and affected its external and internal validity (Higgins and Green, 2011). As a result, the conclusions drawn based on the small sample size will be weak and less generalisable. Additionally, the study used a two group, pre-post non-randomised study design due to time constraints of the PhD research study. Therefore, a lack of randomisation can also have an impact on the study results, as it is considered to be the gold standard and foundation for clinical studies.

Nevertheless, this feasibility study did not aim to assess the effectiveness of the WBI-BACK intervention programme and make generalisations regarding the results. At the same time, inferential statistics were used to identify the changes in outcome measures and determine the most suitable ones to assess the delivery of the WBI-BACK intervention programme to nurses in the KSA for use in a future definitive study. By further refining this intervention with the data acquired during this feasibility study, it is likely that these effects can be changed or

improved. It is also likely that these effects occurred by chance in a feasibility study of this size could change with an increase in sample size.

8.6.2.2 Self-reported Questionnaire

Previous literature has suggested some engagement measurement options that can be used in mHealth and eHealth behavioural change interventions such as: self-reported questionnaires, system usage data, ecological momentary assessments, sensor data and social media (Short et al., 2018). Although more than 80% of the participants engaged with the WBI-BACK intervention, the level of engagement was assessed subjectively through self-reported questionnaires, which represents a weakness of the current study. However, a lack of validity of self-reported questionnaires may affect the feasibility and usability of the WBI-BACK intervention programme, and this is due to the time limitation of the PhD current study. Some studies suggest using the LifeGuide online software programme to collect data objectively, including the logins, module views and time spent on each module (Geraghty et al., 2015; Geraghty et al., 2018). Although many attempts were made to collect this data objectively, they were not successful due to the time limitations of the PhD study. Future work within the nursing population should collect web-based use (login durations) and engagement data through an objective method.

However, it must be noted that there were few benefits of self-reported questionnaire. First, the researcher was able to conduct the questionnaire among wider participants easily. Secondly, collection of extensive quantitative data led to the possibility of generalized findings. Thirdly, due to the fact that the surveyed nurses were closer to the problem of LBP, there existed high possibility of gaining accurate information from the self-reported questionnaires. Nonetheless, there still existed certain constraints related to the usage of self-reported questionnaires. For instance, there existed probability that nurses might have given invalid answers. They might

have not answered truthfully related to sensitive questions. This phenomenon in which participants respond in a socially acceptable manner is termed as Social Desirability Bias (Cave et al., 2014).

Besides this, there existed other problems that adversely affected the questionnaire's reliability and validity. One such problem was existence of response bias. Generally, in the case of response bias, an individual provides response in a specific way irrespective of the question (Sheeran and Zimmerman, 2002). In the current research, during semi-structured interviews, some nurses preferred to give response in terms of yes irrespective of the question content, which gave rise to the acquiescent response bias. Likewise, nurses gave short responses in terms of a mere "no" that resulted into a non-acquiescent bias. Additionally, the use of self-reported questionnaire led to issue related to clarity of items, due to which there existed high risk of getting varying interpretations of the survey questions. Since the questionnaire was structured in terms of its layout, the nurses were limited to provide answers which might not had matched their viewpoints. This low flexibility due to fixed-choice questions limited their ability to express their feelings and experiences freely.

Considering the aforementioned shortcomings of using the self-reported questionnaire, future researchers are suggested to measure reliability and validity of such questionnaires. Testing the reliability of the self-reported questionnaire means dependability or repeatability of a measurement. Generally, a questionnaire is considered reliable if it yields same results repeatedly when used/conducted (Vlot-van Anrooij et al., 2018). Future researchers are suggested to calculate reliability of scales used in the questionnaire. This can be done by calculating coefficient alpha for identifying internal consistency or homogeneity of items of the questionnaire. Usually, at least 0.7 or higher score of internal consistency reflects a reliable questionnaire (Wunsch et al., 2021). Moreover, test-retest method can also be used to assess reliability. As per this method, future researchers can conduct the questionnaire twice among

nurses at different times. In other words, a correlation coefficient will be calculated for the two assessment periods, which will address consistency across time (Wunsch et al., 2021). In case a substantial variation is found by using the test-retest method, then there would be obvious concerns related to validity of the questionnaire.

Validity is defined as the limit to which an instrument measures whatever it is intended to measure (Rothwell, 2018). Future researchers can establish validity for the self-reported questionnaire by correlating scores with a similar instrument. However, this usually requires consideration of various kinds of validity such as content validity, face validity, criterion validity, and construct validity. The future researchers can establish face validity by making sure that the survey items measure the intended parameters of the intervention programme. They can establish content validity by making sure that the questionnaire assesses all desired features of the intervention (recruitment rate, retention rate, feasibility of outcome measure assessment, intervention adherence, and experience of the intervention components based on the TAM).

8.6.2.3 Quality and Fidelity of the Intervention Delivery

This study focused on the feasibility and acceptability of the WBI-BACK intervention programme among a nursing population in the prevention and management of LBP. However, the quality of the intervention content and the duration of the intervention were not assessed. This feasibility study did not assess the broader aspects of the fidelity of the delivery of intervention components objectively, such as by direct observation or audio recordings and self-reported checklists (Toomey, Matthews and Hurley, 2017). It is recommended that future trials assess the fidelity for the digital intervention delivery. The concept of fidelity is explored and critically analysed below with suitable suggestions for future researchers.

Fidelity is defined as a multi-dimensional concept that is relevant at various levels of the intervention such as provider, designer, and the recipient (Lorencatto et al., 2016). It is argued that fidelity evaluation of intervention programmes focuses on examination of a single aspect of fidelity instead of looking at the wider phenomenon. For example, fidelity evaluations either focus on if interventions are delivered as stated, or if the recipients show engagement with, understand, or enact the intervention as planned (Boeckmann et al., 2021). This reflects the importance of evaluating fidelity at the recipient level. Hence, future researchers are suggested to adopt a feedback method in the WBI-BACK intervention programme. As per this approach, fidelity would be measured at provider and designer levels (Knittle, 2014). This could lead to important outcomes related to the impact of intervention feedback received by the clinical staff, and their initial understanding, engagement with, and consequently, implementation of the proposed WBI-BACK intervention programme in daily practice of nurses in the country.

Furthermore, future researchers need to examine fidelity by considering five key dimensions such as design, training, delivery, receipt, and enactment (James et al., 2017).

A study by Sanders et al. (2021) argues that lack of consideration of infidelity in an intervention delivery can produce ambiguous results. Hence, it is recommended to promote and assess fidelity at key stages of WBI-BACK intervention programme, such as its development, piloting and testing on the full scale, and during its examination and reporting. As a first step, fidelity must be promoted prior to recruitment of study participants. A blueprint of the WBI-BACK intervention programme must be developed by clarifying the protocols and including intervention materials such as workbooks or treatment manuals (Walton et al., 2017). Moreover, intervention programme materials must be reviewed among small group of nurses for identifying if they require any training or not. The provision of training offers benefits in terms of rehearsing main skills, facilitating role plays, and offering wider opportunities for feedback (Toomey et al., 2017). In the case of getting feedback or self-observation, video

recording can also be used. Once training will be done, it will be crucial for healthcare providers to a set competency standard and motivate nurses to examine the intervention programme by using checklists or quizzes.

Secondly, a piloting phase must be conducted for observing and assessing the delivery of WBI-BACK intervention programme in hospitals in the country. After seeking consent from nurses (intervention recipients), intervention sessions must be recorded to assess if it is delivered as desired or not. This will also facilitate providing feedback to WBI-BACK intervention programme providers related to strengths and limitations of the intervention. Thirdly, full-scale testing of WBI-BACK intervention programme must be followed by the monitoring of its fidelity. This can be done by asking nurses and healthcare practitioners to complete a checklist to examine which aspect of WBI-BACK intervention programme is delivered or not. This will also allow the observation of quality of associations between nurses and healthcare practitioners in terms of collaboration, warmth, and time spent. However, it is suggested the fidelity must be examined by using objective measures (James et al., 2017). Most importantly, it is suggested that nurses must show an active involvement in self-monitoring. Considering this, healthcare practitioners who implement the WBI-BACK intervention programme are suggested to request nurses to complete and return self-monitoring diaries.

In summary, it can be concluded that intervention fidelity assists in examining complex interventions, since it is important for reliability, validity, and generalisability of intervention outcomes. The intervention fidelity not only assists in identifying facilitators and constraints to effective execution of an intervention, but also highlight key factors that can affect the acceptance of an effective intervention programme in the daily clinical practice. So far, implementation fidelity has been explored. Yet, there exists another type of fidelity i.e., theoretical fidelity that assesses the extent of delivery of theoretical constructs of an intervention by practitioners (Knittle, 2014). Theoretical fidelity is being acknowledged widely

since there exists possibility of bad delivery of an intervention. The healthcare practitioners can assess the theoretical fidelity by monitoring the application of WBI-BACK intervention programme in Saudi hospitals. Moreover, different measurement approaches of theoretical fidelity can be used such as frameworks based on differentiation of fidelity-consistent or fidelity-inconsistent adaptations or using standardised tools that identify the limit to which main aspects of the intervention are executed (Boeckmann et al., 2021).

Yet, Lorencatto et al. (2016) stress that it is crucial to examine factors affecting fidelity in order to evaluate fidelity in a proper way. This can further help in explaining either the real-life application of WBI-BACK intervention programme, or reasons of lack of adoption of WBI - BACK intervention programme in the routine practice of nurses. This can be supported with the study of Toomey et al. (2017), who found possible moderators of fidelity such as responsiveness of participant, complex nature of the intervention, and strategies to facilitate its application. Other contextual factors can also affect including hospital routines, nurses' interest, and access to resources. It is crucial to consider these contextual factors while translating the evidence-based, innovative WBI-BACK intervention programme into real-life nursing practice.

8.6.2.4 Short responses during Data Collection

The findings from the study revealed that in some instances, the participants offered short responses to the questions, thus necessitating further probing by the interviewer, to determine their actual views. However, nearly two-thirds of the recruited nursing participants were not Saudi. Therefore, their true/actual experiences and views may not have been expressed openly, as they may have feared losing their jobs and careers in Saudi Arabia. The propensity of the participants to rely on affirmative or negative short-answer responses can be attributed to cultural differences between the interviewers and the participants. On one hand, it can be

attributed to the fact that since the participants were unable to adhere to the intervention programme (as evidenced by the fact that they mostly visited the education and exercise modules), they may have taken measures to mask this failure or inability to adhere to the intervention programme. The efforts to achieve this outcome are evident from the skeleton answers provided, specifically about certain questions designed to confirm whether the participants adhered to the program as advised and as expected. The answers are characteristic of participants inclined towards concealing their failure. However, the responses reveal to the researcher that there is a need for a change to the interview approach. These changes would enable the researcher to implement interventions to the barriers, to enhance the perceived usefulness and perceived ease of use. Whilst the qualitative data in this feasibility study was used to explore the experiences and views of the participants, the poor data from the qualitative interviews may affect the sample representativeness in the qualitative evaluation.

The social science literature has often shed light on the issue of lack of reporting of true feelings by participants in a questionnaire. The inclination of participant to give responses in a favourable way is known as the Social Desirability Effect (Roxas and Lindsay, 2011). Future researchers must be mindful of this phenomenon while designing any future research study. Yet, it is argued that even though some participants give responses in self-reported questionnaires in a socially desirable manner, this does not mean that the usage of self-reported questionnaires must be eliminated completely. Rather, self-reported questionnaires are still considered as the most valid type of measurement based on the variable to be measured (Evans et al., 2022). Hence, future researchers are suggested to adopt two practical strategies for reducing the social desirability error while conducting self-reported questionnaires. First of all, participants must be allowed to remain anonymous while completing the questionnaire, which can reduce socially desirable responses. Generally, participants give honest responses freely as long as they know their responses cannot be identified at all. In this way, anonymous responses

will motivate participant to remain as truthful as possible. Secondly, socially desirable responses can be avoided by writing unbiased statements or questions.

8.7 Future Research for a Larger Trial

Based on the findings of the current feasibility study, the recommendation for the future research are:

8.7.1 General Study Design

8.7.1.1 *Strengthen Methodology Design*

For the objectives of the present study, the inclusion criteria include nurses with and without LBP to assess the feasibility of the WBI-BACK intervention programme as a treatment and preventive tool. Therefore, future feasibility RCTs study should do in two studies, including different populations with LBP in one study and those with NOLBP in another study, to be assessed against a control group to assess the effectiveness of the WBI-BACK intervention programme. There is a need for a change in the design of the WBI-BACK intervention programme, to increase and harmonize the utility of the different modules for the primary goals of prevention or reduction of LBP within two different studies. The qualitative and quantitative data reveal that there are variations in the popularity of the modules, with those modules included at the start of the program being the most popular, compared with lower in popularity among subsequent modules. The participants attributed this scenario to the fact that access is unidirectional, implying that the first modules are often the start point any time the participants access the programme. Due to time pressures linked to work, the participants tended to only focus on the initial modules, and rarely got through to the final modules, including the psychological unit and health lifestyle modules. Modules can be sent weekly rather than in one

package to enhance engagement, and this method was successfully implemented in the previous literature (Geraghty et al., 2018).

Furthermore, future researchers need to examine fidelity by considering five key dimensions such as design, training, delivery, receipt, and enactment (James et al., 2017). In the case of design, future studies will be required to focus on treatment differentiation, extensive specification of main parts of the WBI-BACK intervention programme, causal assumptions, acceptability, and theoretical underpinnings. In the case of training, it will be required to identify the extent of competencies and training of intervention providers to deliver the WBI-BACK intervention programme. Therefore, training lectures and workshops should be implemented at the beginning of the study to familiarise the participants with the digital intervention. It is also essential to identify the physical activity definition and recommendation based on the American Heart Association guidelines and to help the participants set a weekly plan to increase their physical activity level. Participants can receive a total of 2 hours training workshops with their health care practitioner within group setting (4-10 participants) before they engaged in the digital intervention. Assessment of the knowledge delivered in the training workshops could improve the data rigor.

In terms of delivery, it will be required to identify the extent to which WBI-BACK intervention programme is executed during the intervention period. In terms of receipt, it will be required to identify and analyse the initial understanding and engagement of nurses with the WBI-BACK intervention programme. Lastly, considering enactment, it will be required to identify the extent to which nurses implement the WBI-BACK intervention programme in clinical practice. In short, it can be stated that future researchers must examine fidelity across all of these five factors. This is so because lack of fidelity in any of these factors can reduce internal validity of the research and subsequent outcomes (Walton et al., 2017).

There is also a need for assistance through training. Although the WBI-BACK intervention programme is modelled as a self-management tool, training and other forms of support aimed at scaffolding behavioural change have been found to contribute to the success of the intervention programme by increasing adherence (Geraghty et al., 2020). Ongoing support also leads to reassurance for the implementation of behavioral change (Yang et al., 2019), while Sandal et al. (2019) perceived such support as integral to increased adherence, especially for programmes that are tailored to the needs of the individual participants. Although the WBI-BACK intervention programme is tailored to fit the needs of the individual users, the commonalities in the modules and problems facing the participants make it possible for group training sessions whereby a robust feedback loop can stimulate behavioural change. Such sessions also increase engagement with the intervention programme. Moreover, there are variations on the most effective approach to training, such that Van Erp et al. (2020) preferred individual training, while Sandal et al. (2019) promoted group training. These differences can be attributed to the cautions offered by Cherkin et al. (2018) and Middleton et al. (2020) regarding the effects of the STarT Back risk stratification strategy of the intervention approaches based on the various domains. Training is perceived as an approach for harmonising the educational levels of the study participants, and ultimately, contributing to concordance in their expectations and experiences from the intervention. The two studies recognised the prevalence of variations in the stratification approaches, as well as the fact that the interventions introduced on account of stratification may not have unique effects in terms of behavioural change, or on the clinical outcomes.

8.7.1.2 *Increased Sample Sizes*

For the purpose of the current feasibility study, the sample size was too small due to the limitation of the PhD study. As a matter of fact, there exists lack of clarity related to the required sample size in feasibility studies. Even though there is no consensus, the general

suggested size is at least 10-12 participants in each group, and maximum size of 60-75 participants in each group as per the research objective. The median sample size of feasibility studies ranges from 30 to 36 participants per group; yet it is varied on a large scale (Lewis et al., 2021). This is so because there are other factors that may inform sample size such as a feasibility parameter's precision, effect size, event rate, or a clinical parameter's precision in terms of standard deviation (Orsmond and Cohn, 2015).

According to Teresi et al. (2022), the sample size must be selected by considering practical aspects such as budgetary limitations, flow of participants, and the required number of participants for assessing goals of the feasibility study. In quantitative studies, feasibility can be established by using a sample size of 30 participants in each control and intervention groups. The evidence from these different authors reflects a confusing array of recommendations regarding the sample size. Nonetheless, large samples are preferred for examining outcome and process variables (Lewis et al., 2021).

Furthermore, the study by Poplawski and Binder (2017) found that the precision of estimating different end targets reflects the required sample size for any feasibility study. The end targets of a feasibility study can include compliance of participants with the study protocol, determination of response rates, conducting a questionnaire, or estimating attrition and adherence. If the feasibility study focuses on identifying appropriateness of an intervention/instrument as one of its key goals, then test-retest reliability or Cronbach's alpha can be calculated (Teresi et al., 2022). Considering this, future researchers are recommended to calculate the sample size that can attain precision at acceptable confidence level. In case they want to estimate other parameters of WBI-BACK intervention programme in terms of calculating proportions, means, and standard deviations, then they are suggested to consider this into the targeted sample size for the feasibility study.

Another rule of thumb in this regard is that there must be 30 participants per estimated parameter for a feasibility pilot study. Consequently, 80% upper one-sided confidence limit can be used for estimating the power for the larger trial (Poplawski and Binder, 2017). Based on this, the future researchers are suggested to conduct a feasibility pilot study, and target 30 participants per progression feasibility criteria (recruitment rate, retention rate, feasibility of outcome measure assessment, intervention adherence and experience of the intervention components based on the TAM). In other words, the future researchers must maintain a balance between logistically and financially realistic outcomes, and the possible results of imprecision if applied to the larger trial.

8.7.1.3 *Lengthen Duration of Follow up*

Future studies should examine the long-term interventions' effects on clinical and psychological outcome measures. Based on the literature, many studies involved short-term outcomes and did not address longer-term outcomes, especially in behavioural change intervention (Llewellyn-Bennett et al., 2016).

8.7.2 Study Planning

The MRC guidelines highlight the importance of theory-driven methodology for developing, planning and evaluating interventions (Craig et al., 2008). The current feasibility study has successfully applied SCT and TAM theories, which helped us to understand the drivers of behavioural self-management. Future studies should incorporate more theories to enhance engagement and understand how participants influence or motivate a new behaviour. This can be achieved through several alternatives, including Cognitive Behavioural Therapy (CBT), Behavioural Change Wheel (BCW) and Goal Setting Theory. Garg et al. (2016) have defined CBT as the collection of psychosocial interventions designed to enhance the mental health of individuals involved in any therapeutic program, by changing and/or challenging the cognitive

distortions or behaviours that influence engagement to the web-based intervention programme. Through CBT, the management/oversight teams can improve the regulation of emotions, while injecting novel coping strategies at a personal level, to solve emergent and extant problems. The two direct benefits include reduction in LBP for those already affected by the problem, and prevention of its onset among employees. Although there is limited data on the prevalence of the problem in the institution and industry, it is widely acknowledged that LBP affects the productivity and performance of employees in the workplace. The elimination of some of the generic barriers affecting the WBI-BACK intervention programme will have two key effects on its feasibility and acceptability. First, it will introduce a key element in the form of organisational support, for employees with the necessary motivation to participate, whether or not they suffer from LBP. These include psychotherapeutic elements for creating a relationship among the participants and enhancing the positive attitude towards the WBI-BACK intervention programme, as well as other forms of reinforcement to improve the resilience of the users. Second, it will lead to harmonisation in the use of the intervention programme, including the modules accessed, and ultimately, lead to equity in the ability of the employees to self-manage LBP, or engage in preventive measures, depending on their situation. CBT can be deployed in a digitised online form, or through offline means, depending on the context. The outcome will be increased parity in the access to all modules by the employees with or without LBP, an increase in PA and improvement in the choice of physical activities, depending on whether their goal is to prevent or reduce LBP. The main barriers to be solved by the management teams include the provision of internet connection at work, and provision of digital access tools such as computers and mobile phones.

Importantly, the WBI-BACK intervention programme could be designed with more interactive features, such as reminders to enable the users to establish a routine. Such routines are necessary for ensuring progressive adherence to the intervention programme, as well as

reducing the need for manual logging of the activities that the individual is involved in. The inclusion of reminders or other sensory objective tools would provide increased socialisation, as well as motivating the users to adhere to a particular module. This suggestion is supported by findings by Krein et al. (2013), who indicated that the use of pedometers to automatically record PA and thus create online feedback, led to better data on the use of the intervention programme and improvements in the reduction of LBP among the participants. Such inclusions help reduce the multiplicity of requirements for users, thereby enabling them to focus on activities that contribute to their primary goals, while delivering secondary goals such as reliable data on progress.

Finally, future trials should focus on the diversity of platforms for intervention delivery. Integration of web-based intervention with applications (apps) could enhance acceptability and flexibility towards behavioural intervention programmes.

8.8 Implications for Practice

Web-based programmes provide users with tailored advice for self-management for a broad range of clinical interventions (Geraghty et al., 2015; Weymann et al., 2015). Among the clinical interventions for LBP, self-management programmes focus on increasing or changing the levels and types of PA, with the results ranging from physical to mental health outcomes. However, Martorella et al. (2017) have found that tailored web-based interventions have not been proven to be more effective than standardised alternatives in terms of reducing pain intensity, disability arising from pain, and psychological outcomes such as depression and anxiety. In spite of disparity in clinical results, these web-based intervention programmes have been found to deliver significant results in the reduction of pain catastrophisation.

8.8.1 Implications for Practice in the KSA

The findings from this study suggest that the relevant authorities and policy makers in the health sector need to increase their roles in PA promotion and providing recreational-related PA for nurses and other healthcare providers in hospitals and set a work-free day in which all nurses can be routinely engaged in PA for promotion of their general health.

Secondly, the government health promotion strategy needs to support health promotion in the workplace area and adopt more approaches for health promotion activities. Most healthcare workers spent more than half of their waking hours at their work, thus making the workplace setting an ideal place for health promotion activity. Health promotion at work can reduce sickness levels, increase stress tolerance and lead to economic benefits for organisations (Mceachan et al., 2008; Goetzel et al., 2008).

Finally, the blended physiotherapy treatment approach is a new innovation in the field of intervention approaches for patients with LBP (Kloek et al., 2019). The integration of a web-based intervention with supervised physiotherapy treatment would be suitable for patients with LBP and stimulate their ability to self-manage their LBP. It is recommended that future studies seek to develop, evaluate and implement blended intervention as a treatment approach for patients with chronic diseases in Saudi hospitals.

8.9 Conclusion

This research is one of the first in its domain to employ a theory web-based intervention to promote behavioural self-management for nurses with and without LBP (i.e. the WBI-BACK intervention programme). The WBI-BACK intervention programme uses a self-tailored cognitive behavioural method based on SCT. The specific objectives of the WBI-BACK programme are to: (1) promote PA, (2) use specific LBP exercises to alleviate pain and

disability, (3) promote ergonomics intervention and (4) improve mental health, wellbeing and healthy lifestyles. The primary objective of this study was to evaluate and assess the feasibility and acceptability of the WBI-BACK intervention programme among nurses working in Saudi hospitals.

The feasibility study has informed the suitability of the research protocol for a future full-size RCT. The results demonstrated the feasibility of the research process, data collection and the acceptability of the WBI-BACK intervention programme among nurses with and without LBP and have informed recommendations to help improve its delivery in future studies. The secondary objective of this research was to determine the likelihood of changes in LBP outcome measures (IPAQ, SF-12, SEE, FABQ, NRS and RMDQ), and identify the appropriateness of the outcomes to evaluate the delivery of the WBI-BACK intervention in KSA. The results demonstrate a significant change in moderate physical activity and RMDQ outcomes, while there were no changes in other outcome measures in both LBP and NOLBP groups. Although these results need to be confirmed by a RCT in the future, this can be attributed to many reasons, such as intervention duration and engagement level among the participants.

The findings of this study offer encouraging avenues for future research in the KSA and could embolden policy makers and hospital managers to implement relevant eHealth interventions and digital intervention within routine healthcare systems in Saudi Arabia. For successful implementation, digital health intervention programmes should be implemented simultaneously, so that current and future health care professionals are able to develop the required positive attitudes, as well as practical skills and competencies.

Finally, web-based intervention is effective and has shown promising results for behavioural self-management for LBP among nurses if guided by evidence-based practice and theoretical constructs.

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Appendices

Appendix 1

Data Extraction from Systematic Review Articles Included

Study/ Setting	Design	Population (Sample characteristics)	Intervention	Outcome measure and time points	Effect of physical activity intervention on LBP
1- Amorim et al. (2019) -Outpatient physiotherapy department of four public hospitals and from general community in Sydney metropolitan area. The recruitment was expanded to include people discharged from a hospital-based physiotherapy treatment and from private practice (e.g. GP, chiropractic, and physiotherapy).	- A pilot RCT with blinded outcome assessment. - Feasibility study	- n = 68 - Chronic LBP persisting for over 12 weeks.	Intervention Group (n = 34, mean age: 59) - Patients received a physical activity and sedentary behaviours information booklet plus one face-to-face and 12 telephone-based health coaching sessions. The intervention was maintained by an internet-based application and an activity tracker (Fibit). Control Group (n = 34, mean age: 57) - Patients received the physical activity information booklet and advice to stay active.	Feasibility Measures - Recruitment rate - Intervention compliance - Data collection - Participant Satisfaction Primary Outcomes (Collected weekly during 6 months of the intervention) - Care seeking - Pain level, (NRS¹) - Activity limitation - Activity limitation (Disability), (RMDQ²) Secondary Outcomes (Collected at baseline and 6 month follow up) - Self-reported physical activity (IPAQ³)	Physical activity intervention for people with chronic LBP involving health coaching, activity trackers and m-health over 6 months is feasible and acceptable by target population. Health coaching physical activity approach may reduce care seeking in patients with LBP after treatment discharge.
2- Ben-Ami et al. (2017) - Multi-centered physical therapy in Israel.	- Prospective, pragmatic, non-randomised controlled clinical trial.	- n = 220 - Chronic LBP greater than 3 months, with or without radiation to the lower limbs.	Intervention Group: Enhanced Transtheoretical Model intervention (ETMI) (n=109, mean age: 42) - It was delivered by physical therapists and based on behavior-change principles, combined with increased reassurance, therapeutic alliance, and exposure to reduce fear avoidance. - One-to-one treatment session, minimum of 2 with no upper limit. -The main principle of the intervention was to reach a mutual decision regarding recreational physical activity such as walking, swimming, biking or gym workout.	Primary outcome (Collected at 3 and 12 months) - Disability (RMDQ²) Secondary Outcomes (Collected at 3 and 12 months) - Pain intensity, (NRS¹) - Mental and physical health, (SF-12⁴) - Level of physical activity (BPAQ⁵).	Patients at 12 months had significantly decreased disability and pain, and improved physical health and physical activity in the intervention group compared to the control group.

			Control group (n =111, mean age : 42) - Patients received conventional physical therapy treatments including: mobilization, manipulation, back exercise, postural training, attending back school, electrical stimulation, short wave diathermy, cooling and stretching.		
3- Chhabra et al. (2018) - Outpatient Spine Department in private hospital in New Delhi, India.	- Single-blinded RCT (with blinding of the outcome assessor)	- n = 93 - Mechanical LBP persisting for over 12 weeks with or without radicular symptoms and undergoing treatment.	Intervention Group: App group (n = 45, mean age: 41) - Patients received Snapcare and regular written prescription from physician. Through the Snapcare App, the patients received daily physical activity goals including back and aerobic exercises. Control Group (n = 48, mean age: 41) - Patients received a written prescription from physician, containing a list of prescribed medicines and dosages and stating the recommended physical activity level including home exercise.	Primary outcomes (Collected at baseline and at the end of 12 weeks) - Pain level, (NRS ¹) - Disability, (MODI ⁶) Secondary outcomes (Collected at baseline and at the end of 12 weeks (about 3 months) for intervention group only) - Daily physical activity (Distance measured through an activity tracker built within the app) and progress in symptoms through CSS (Current Symptom Score).	- Both the groups showed significant improvement in pain and disability with greater significantly decrease in disability in the App group. - Snapcare facilitated increase in physical activity and brought about clinically meaningful improvement in pain and disability in patients with chronic LBP
4- Geraghty et al. (2018) - 12 general practices in England.	-Three-armed RCT	- n = 87 - Patients had current LBP within at least 2 weeks.	Group 1: Usual care (n =26, mean age: 60) - Patients received usual care for their LBP over the trial period. Group 2- Internet intervention plus usual care (n = 29, mean age: 54) - Patients received usual care for their LBP and also received access to the SupportBack internet intervention for 6-weeks. - Tailored program, focused on graded goal-setting, self-monitoring and provision of tailored feedback to encourage physical activity. Group 3- Internet intervention plus physiotherapist telephone support plus usual care (N =27, mean age: 59) - Patients continued to receive usual care for LBP and access to SupportBack internet. In addition, physiotherapist telephone support consisted of three brief telephone calls over a 4-week period, to address any concerns and provide reassurance.	Primary outcomes (feasibility of the trial design) - Recruitment rate - Attrition rate - Adherence and retention at follow up. Secondary outcome (Collected at baseline and at 3 months) - LBP related disability, (RMDQ ²) - Pain level, (NRS ¹) - Risk of persistence disability, (STarT Back tool) - Fear of movement, (TSK ⁷) (Catastrophising Scale) - Self reported physical activity, (IPAQ-SF ⁸)	- The study is feasible of future definitive RCTs to determine the clinical and cost-effectiveness of the SupportBack. - Digital approach with or without health care support have potential to offer an accessible means of effectively supporting behaviour in LBP patients.

5- Hurley et al. (2015) - 5 Outpatient physiotherapy departments in Dublin, Ireland.	- Assessor -blinded prospective RCT with 3 parts	- n = 246 -Chronic LBP with/without radiation to the lower limb, duration > 3 months, or recurrent > 3 episodes in previous 12 months	Group 1: Walking program (WP), Biopsychosocial intervention model (n = 82, mean age :46) - Patients had educational walking booklets, walking diaries and a request to record their daily frequency and duration of walks for a 7-day period before the start of WP. They were also given a pedometer model to record their step count for each day's walking for 1 week, and then returned to the physiotherapist for recording. It was aimed to increase to progress walking to the 30 minutes of moderate intensity physical activity for 5 days. For the remainder of program (7 weeks), the treating physiotherapist made weekly contact for each participant via telephone to evaluate the progress of walking. Group 2: Exercise Class (EC), Biopsychosocial intervention model, (n = 83, mean age: 45) -EC followed a group-based circuit format based on the "Back to Fitness" program. Patients were required to attend once/week, 8 weeks for 1 hour classes in the gymnasium of the hospital. Exercise components included warm up and stretching. Group 3: Usual physiotherapy (US), (n = 81, mean age: 44) - Patients received a combination of individual education/advice, exercise therapy and manipulative therapy as the normal treatment for LBP in Ireland, with no restriction of number of visits.	Primary outcome (Collected at baseline, and 3, 6 and 12 months) - LBP related disability, (ODI⁹) Secondary outcomes (Collected at baseline, and 3, 6 and 12 months) - Pain level, (NRS¹) - Health-related quality of life, (EuroQol EQ-5D-3L Weighted Health Index) - Fear-avoidance due to physical activity in the context of back pain, (FABQ-PA ⁹) - Self-reported physical activity (IPAQ³) - Self-efficacy, (ESE¹⁰) - Stage of exercise behaviours change, Readiness to Change Questionnaire.	- The findings showed significant improvements in ODI, NRS, FABQ-PA and EuroQol EQ-3L Weighted Health Index, but no significant between group differences and small between group effect size. - Supervised walking provides an effective alternative to current forms of chronic LBP management. - There were trends to higher percentage of participants in the WP and UP groups in the moderate category of the IPAQ at 6 and 12 months.
6- McDonough et al., 2013) - Primary care practice referral lists of 2 hospital's physiotherapy departments in Northern Ireland (The Robinson Memorial Hospital, Ballymoney and the Fort Centre, Coleraine).	- Feasibility RCT.	- n = 57 - LBP with or without radiation and persisting for > 12 weeks.	Group 1: Education /advice (E), (n = 17, mean age: 51) - In week 1, patients received a single, one-to-one session (approximately 1 hour by physiotherapist who gave a standardized education / advice to remain active "Back Book." Group 2: Education with pedometer (EWP) (n = 40, mean age: 48) - Patients received a same intervention in group 1 with 8-week graded pedometer-driven walking program.	EWP Group - Step targets - Actual daily step counts - Adverse events were recorded in a walking diary over 8 weeks. Both E and EWP Groups (Collected at baseline, week 9 and at 6 months). - LBP related disability, (ODI⁹) - Health-related quality of life, (EuroQol EQ-5D-3L Weighted Health Index) - Pain level, (NRS¹) - Self reported physical activity, (IPAQ-SF⁸), at baseline only. - Fear avoidance beliefs (FABQ¹¹)	- Pedometer-driven walking has been advocated as a safe and effective means for increasing physical activity in sedentary adults, and recent reviews observe an increase of approximately 200 steps/day as a result of walking interventions. - Participants in EWP perceived that their physical activity level had improved more than E group.

				- Back beliefs, (Back Beliefs Questionnaire) - Self-efficacy, (PA Self-efficacy Scale)	
7- Schaller et al. (2016) - Inpatient medical rehabilitation and aftercare in Germany.	- Single centre RCT, single blinded.	- n = 412 - Patients were starting an inpatient medical rehabilitation treatment due to LBP.	Group 1: The intervention, Movement Coaching, (n = 201, mean age: 50) - Movement coaching: designed as multicomponent approach and comprised of 3 components: (1) Face-to-face contact (small group intervention, twice during inpatient rehabilitation). (2) Tailored telephone aftercare (8weeks and 12 weeks after rehabilitation). (3) Internet-based aftercare (web 2.0 platform) available up to six months after rehabilitation. Group 2: Control intervention (n = 211, mean age: 51) - Low intensity intervention control group comparison of two general presentations on physical activity during inpatient rehabilitation, which could be download from a home page during aftercare.	Primary outcome (Collected at baseline and 6 months) - Global Physical Activity Questionnaire, total physical activity (MET-min/week) Secondary outcomes (Collected at baseline and 6 months) - Leisure time physical activity (MET-min/week) - Workplace Physical activity (MET-min/week) -Transport physical activity (MET-min/week) - Pain intensity measured by (SF-36)	- In both groups, physical activity decreased during the six months follow-up. - At six months follow-up, no significant differences between the two groups in total physical activity and all secondary outcome measures.

Abbreviations:

NPRS¹, Numeric Pain Rating Scale.

RMDQ², Roland Morris Disability Questionnaire.

IPAQ³, International Physical Activity Questionnaire

SF-12⁴, Medical outcomes Study 12-item Short-Form Health Survey.

BPAQ⁵, Baecke Physical Activity Questionnaire.

MODI⁶, Modified Oswestry Disability Index.

TSK⁷, Tampa Scale for kinesiophobia.

IPAQ-SF⁸, International Physical Activity Questionnaire Short Form.

FABQ-PA⁹, Fair Avoidance Beliefs Questionnaire –Physical Activity subscale.

ESE¹⁰, Exercise Self Efficacy Questionnaire.

FABQ¹¹, Fear Avoidance Beliefs Questionnaire

Appendix 2

Evaluation Toolkit for Reusable Learning Objects and deployment of e-Learning Resources

Adapted from the RLO-CETL Evaluation Toolkit (2005)

Supporting references:

Wharrad, H.J., Morales, R., Windle, R., Bradley, C., 2008 A toolkit for a multilayered, crossinstitutional evaluation strategy. *World Conference on Educational Multimedia, Hypermedia and Telecommunications* vol. 2008, No. 1, pp. 4921–4925 (Jun 30).

Morales, R., Carmichael, P., Wharrad, H. J., Bradley, C., & Windle, R. (2006). Developing a Multi-Method Evaluation Strategy for Reusable Learning Objects: an approach informed by Cultural-Historical Activity Theory. Presented at *The 1st European Practice-based and Practitioner Research Conference - Improving Quality in Teaching and Learning: Developmental work and Implementation Challenges*, University of Leuven, Belgium.



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RLO Evaluation Toolkit

RLO Evaluation Form

To be attached at the end of each RLO. The questions to be asked are:

1. How would you rate this learning object?

Excellent

Good

Not very good

Poor

2. How easy was it to use the learning object?

Very easy

Easy

Not very easy

Difficult

3. How helpful has the learning object been for learning this subject?

Very helpful

Helpful

Not very helpful

Completely unhelpful

4. Would you recommend it to others?

5. What did you like most about this learning object?

6. What did you not like about this learning object?

7. Are you a student or a member of staff?

8. Which module are you studying/teaching?

9. Which university/institution are you from?

10. If you would be willing to give more detailed feedback on this and other learning objects, please fill in your details below.

Name:

Email address:

Appendix 3

Poster advertising for the study in the Rehabilitation Hospital at KFMC



University of Nottingham
UK | CHINA | MALAYSIA



وزارة الصحة
مدينة الملك فهد الطبية
King Fahad Medical City

Developing and Feasibility Testing of Web Based Intervention for Self Management of Low Back Pain in Nurses

Nurses and nursing assistants with
and without pain
are invited to participate

The study is a web-based intervention for the self-management of low back pain, aiming to help you prevent and manage your back pain

You will be able to access this intervention programme as often as you can for a period of six weeks. There are also activities to do each week, such as walking or specific back exercises.

YOUR PARTICIPATION IS APPRECIATED



Anywhere



For more information and participation please email Rana ALduraywish
ntxraa@nottingham.ac.uk
Rana ALduraywish is a PhD student at the Nottingham University, School of Health Science, supervised by Dr. Paul Hendrick and Dr. Holly Blake

Appendix 4

Participant Information Sheet



University of
Nottingham
UK | CHINA | MALAYSIA



Participant Information Sheet

Research Title

Development and Feasibility Testing of Web-Based Intervention for Self-Management of Low Back Pain in Development and Feasibility Testing Nurses. A Mixed Method Study.

Name of Chief Investigator

Rana Alduraywish, PhD researcher; Dr. Paul Hendrick; Dr. Holly Blake

Invitation

We would like to invite you to take part in our research study. Before you decide we would like you to understand why the research is being done and what it will involve for you. One of our team will go through the information sheet with you and answer any questions you have. Please talk to others about the study if you wish. Please ask the researcher if there is anything that is not clear.

What is the purpose of the study?

The purpose of the study is to explore whether a web based self-management intervention program (WBI-BACK) can be used to help manage and prevent low-back pain in nurses and/or nursing assistants working in Saudi Arabian hospitals. Additionally, we will investigate whether this digital intervention (WBI-BACK) can be delivered nationally and is acceptable for nurses working in Saudi Arabia.

Why have I been invited?

You are being invited to take part because nurses are at increased risk of developing low-back pain. Your opinions will be used to ensure whether this WBI-BACK intervention can be delivered, acceptable and helpful to manage and prevent your back pain. We are inviting 50 participants to take part in the study.

Do I have to take part?

It is up to you to decide whether to take part. If you do decide to take part:

- 1- Please keep this information sheet.
- 2- Please sign the consent form.
- 3- If you would like any further information, please do not hesitate to contact Rana Alduraywish on ntxraa@nottingham.ac.uk

If you decide to take part, you are still free to withdraw at any time and without giving a reason. This would not affect your legal rights.

What will happen to me if I take part?

I will arrange a meeting in the King Fahad Medical City (KFMC) hospital for 30 minutes at a convenient time for you. On arrival, the researcher will explain the study to you, provide a consent form for you to sign and outcome measures questionnaires for you to complete. Additionally, you will receive a link to the web-based intervention program (WBI-BACK) via email which will give you access to the intervention package for a period of six weeks. You will be able to access the intervention program from a computer at the hospital or from home until the end of the study. You will be encouraged to explore one of six modules every week, depending on your availability.

The main rationale underlying the intervention is that keeping active is important for managing and preventing back pain. The intervention suggests two forms of activity will be performed each week. These two activities are walking and specific back exercises. You will select one activity each week and set goals accordingly. You will be also asked to keep a diary of your activity to monitor progress. After the intervention, you will be asked to complete outcome measures questionnaires again. You may also attend an hour-long training lecture and workshop held in the KFMC hospital to familiarise yourself with the digital intervention program.

If you are interested in taking part in the second phase of the study, you will be invited for an interview after the WBI-BACK intervention. The interview will be used to record your views on the WBI-BACK intervention and to assist in evaluating it. This interview will be held in the physiotherapy department at the KFMC Hospital and will last between 30-60 minutes. An audio recording of the interview will be created.

What are the possible disadvantages and risks of taking part?

This project is considered a low-risk study. All exercises and activities are recommended (walking and specific back exercises) for back pain and are explained in detail. It is not anticipated that there will be any adverse events however, any adverse events will be recorded and reported, and any serious adverse events will be reported to the Ethics Committee. Where necessary, the events will be discussed with the Chief Investigator of this study, and you will be referred to your doctor/GP if necessary.

What are the possible benefits of taking part?

We cannot promise the study will help you to prevent and manage your low back pain but the information we get from this study will help us to assess the suitability of this digital intervention program for nurses and nurse aides. This will be the first study of its kind to look at the issues specifically within the context of Saudi Arabia. Therefore, the results will

provide information on the suitability of this web-based intervention to be tested in a future trial.

What if there is a problem?

If you have any concerns about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. The researchers' contact details are given at the end of this information sheet. If you remain unhappy and wish to complain formally, you should then contact the FMHS Research Ethics Committee Administrator, c/o The University of Nottingham, Faculty PVC Office, B Floor, Medical School, Queen's Medical Centre Campus, Nottingham University Hospitals, and Nottingham, NG7 2UH. E-mail: louise.sabir@nottingham.ac.uk.

In the event that something does go wrong and you are harmed during the research and this is due to someone's negligence, then you may have grounds for a legal action for compensation against the University of Nottingham but you may have to pay your legal costs.

Will my taking part in the study be kept confidential?

We will follow ethical and legal practice and all information about you will be handled in confidence. If you join the study, some parts of the data collected for the study will be looked at by authorised persons from the University of Nottingham who are organising the research. They may also be looked at by authorised people to check that the study is being carried out correctly. All will have a duty of confidentiality to you as a research participant and we will do our best to meet this duty.

All information which is collected about you during the course of the research will be kept **strictly confidential**, stored in a secure and locked office, and on a password protected database at the University of Nottingham. Any information about you which leaves the institution will have your name and address removed (anonymised) and a unique code will be used so that you cannot be recognised from it.

Your personal data (email, and telephone number) will be kept for two years after the end of the study so that we are able to contact you about the findings of the study and possible follow-up studies (unless you advise us that you do not wish to be contacted). All other data (research data) will be kept securely for 7 years. After this time your data will be disposed of securely. During this time all precautions will be taken by all those involved to maintain your confidentiality, only members of the research team will have access to your personal data. We would also like to seek your consent so that the data may be

stored and used in possible future research during and after 7 years – this is optional (please indicate you agree to this on the consent form).

What will happen if I don't want to carry on with the study?

Your participation is voluntary, and you are free to withdraw at any time, without giving any reason, and without your legal rights being affected. If you withdraw, we will no longer collect any information about you or from you, but we will keep the information about you that we have already obtained as we are not allowed to tamper with study records and this information may have already been used in some analyses and may still be used in the final study analyses.

What will happen to the results of the research study?

The study being a requirement for the award of a doctoral degree, it is anticipated that findings from the study will be disseminated at various stages of the study (from introduction to the conclusion of the main study) in an appropriate scientific journal in open access journals for wider coverage, poster and oral presentations in KSA and at international conferences. You can ask the researcher to have a copy of the publication sent to you and you will not be identified in any report/publication.

Who is organising and funding the research?

This research is being organised by the University of Nottingham and is being funded by the Saudi Arabian Cultural Bureau in London.

Who has reviewed the study?

All research in the University of Nottingham is looked at by an independent group of people who are known as the Research Ethics Committee, and this is done to protect your interests. This study has been reviewed and given favourable opinion by the Faculty of Medicine & Health Sciences (FMHS) Research Ethics Committee.

Further information and contact details

Investigators	Name	Emails
Principle investigator	Rana Alduraywish	ntxraa@nottingham.ac.uk
Chief investigators	Dr. Paul Hendrick	paul.hendrick@nottingham.ac.uk
	Dr. Holly Blake	holly.blake@nottingham.ac.uk

Appendix 5

Quantitative Consent Form

CONSENT FORM

Development and Feasibility Testing of Web Based Intervention for Self Management of Low Back Pain in Nurses. A Mixed Method Study

Name of Researcher: **Rana Alduraywish**

Please initial box

1. I confirm that I have read and understand the information sheet version number..... datedfor the above study and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without my medical care or legal rights being affected. I understand that should I withdraw then the information collected so far cannot be erased and that this information may still be used in the project analysis. ☐
3. I understand that relevant sections of my data collected in the study may be looked at by the research group and by other responsible individuals for monitoring and audit purposes. I give permission for these individuals to have access to these records and to collect, store, analyse and publish information obtained from my participation in this study. I understand that my personal details will be kept confidential. ☐
7. I agree to take part in the above study. ☐

_____ Name of Participant	_____ Date	_____ Signature
_____ Name of Person taking consent	_____ Date	_____ Signature

2 copies: 1 for participant, 1 for the project notes

Appendix 6

Quantitative Outcome Measures Questionnaires

1- International Physical Activity Questionnaire (IPAQ)

Short: Last 7 Days Self-Administered version of the IPAQ

Participants will provide the time spent in walking, undertaking moderate and vigorous activity as well as sedentary activity, in the last seven days.

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____Days per week

☐ No vigorous physical activity Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?

_____ Hours per day

_____ Minutes per day

☐ Don't know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads as part of your work? Please do not include walking.

_____ Days per week

☐ No moderate physical activity Skip to question 5

4. How much time did you usually spend on doing moderate physical activities on one of those days?

_____ Hours per day

_____ Minutes per day

☐ Don't know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

_____ Days per week

☐ No walking

Skip to question 7

6. How much time did you usually spend walking on one of those days ?

_____ Hours per day

_____ Minutes per day

☐ Don't know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the last 7 days, how much time did you spend sitting on a week day?

_____ Hours per day

_____ Minutes per day

☐ Don't know/Not sure

1- Physical Activity Questionnaire

1-How many days a week were you physically active at a moderate intensity level for 30 minutes in succession on at least 5 days a week?

(Moderate activity is defined as any form of activity that causes a small increase in your breathing or heart rate (such as brisk walking, bicycling, vacuuming or gardening)

- ☐ None started
- ☐ 1 day
- ☐ 2-3 days
- ☐ 4-5 days
- ☐ Everyday

2- How many days a week were you physically active at a vigorous intensity level for 20 minutes in succession on at least 3 days a week?

(Vigorous activity is defined as any form of activity that causes a large increase in your breathing or heart rate (such as running, aerobics or heavy yard work)

- ☐ None started
- ☐ 1 day
- ☐ 2-3 days
- ☐ 4-5 days
- ☐ Everyday

2- Fear-Avoidance Beliefs Questionnaire (FABQ)

Participants beliefs about work and physical activity will be assessed that influence by LBP.

Here are some of the things which other patients have told us about their pain. For each statement please circle any number from 0 to 6 to say how much physical activities such as bending, lifting, walking or driving affect or would affect your back pain.

	Completely disagree			Unsure		Completely agree	
	0	1	2	3	4	5	6
1-My pain was caused by physical activity.....	0	1	2	3	4	5	6
2-Physical activity makes my pain worse.....	0	1	2	3	4	5	6
3-Physical activity might harm my back.....	0	1	2	3	4	5	6
4-I should not do physical activities which (might) make my pain worse	0	1	2	3	4	5	6
5-I cannot do physical activities which (might) make my pain worse.....	0	1	2	3	4	5	6

The following statements are about how your normal work affects or would affect your back pain

	Completely disagree			Unsure		Completely agree	
	0	1	2	3	4	5	6
6-My pain was caused by my work or by an accident at work.....	0	1	2	3	4	5	6
7-My work aggravated my pain.....	0	1	2	3	4	5	6
8-I have a claim for compensation for my pain.....	0	1	2	3	4	5	6
9-My work is too heavy for me.....	0	1	2	3	4	5	6
10-My work makes or would make my pain worse.....	0	1	2	3	4	5	6
11-My work might harm my back.....	0	1	2	3	4	5	6
12-I should not do my normal work with my present pain...	0	1	2	3	4	5	6
13-I cannot do my normal work with my present pain.....	0	1	2	3	4	5	6
14-I cannot do my normal work till my pain is treated.....	0	1	2	3	4	5	6
15-I do not think that I will be back to my normal work within 3 months.	0	1	2	3	4	5	6
16-I do not think that I will ever be able to go back to that work.....	0	1	2	3	4	5	6

Scoring

Scale 1: fear-avoidance beliefs about work – items 6, 7, 9, 10, 11, 12, 15.

Scale 2: fear-avoidance beliefs about physical activity – items 2, 3, 4, 5

3- Pain Intensity

Numeric Rating Scale (NRS)

Participants rate their current pain and average last 2 weeks on a 11-point rating scale (0; no pain to 10, maximum pain) at baseline and after the intervention.

If a zero (0) means ‘no pain’ and a ten (10) means ‘pain as bad as it could be’, on this scale of 0–10, what is your average for low back pain intensity during the last 2 weeks? Put an “X” through that number.

0	1	2	3	4	5	6	7	8	9	10
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	-----------

4- Physical Functioning

Roland–Morris Questionnaire (RMQ)

Participants select from a list of items (N=24) which describe their LBP experience during the day on scale. The scale is dichotomous, and the participants will choice if the symptom is present or not at baseline and after the intervention.

As you read the list, think of yourself today. When you read a sentence that describes you, put a tick against it. If the sentence does not describe you, then leave the space blank and go on to the next one. Remember; only tick the sentence if you are sure it describes you.

I stay at home most of the time because of my back.

I change position frequently to try and get my back comfortable.

I walk more slowly than usual because of my back.

Because of my back I am not doing any of the jobs that I usually do around the house.

Because of my back, I use a handrail to get upstairs.

Because of my back, I lie down to rest more often.

Because of my back, I have to hold on to something to get out of an easy chair.

Because of my back, I try to get other people to do things for me.

I get dressed more slowly than usual because of my back.

I only stand for short periods of time because of my back.

Because of my back, I try not to bend or kneel down.

I find it difficult to get out of a chair because of my back.

My back is painful almost all the time.

I find it difficult to turn over in bed because of my back.

My appetite is not very good because of my back pain.

I have trouble putting on my socks (or stockings) because of the pain in my back.

I only walk short distances because of my back.

I sleep less well because of my back.

Because of my back pain, I get dressed with help from someone else.

I sit down for most of the day because of my back.

I avoid heavy jobs around the house because of my back.

Because of my back pain, I am more irritable and bad tempered with people than usual.

Because of my back, I go upstairs more slowly than usual.

I stay in bed most of the time because of my back.

5- Health Related Quality of Life

12-Item Short –Form Health Survey SF-12

Instructions: This survey asks for your views about health. This information will help keep track of how you feel and how well you are able to do your usual activities.

Please answer every question by making one box, if you unsure about your answer, give the best answer you can.

Participants will score their health status in 8 health concepts including: physical and social function, bodily pain, vitality, mental health, emotional health and general health. A high score reflect a better quality of life.

Choose one option for each questionnaire item.

1. In general, would you say your health is:

1 - Excellent

2 - Very good

3 - Good

4 - Fair

5 - Poor

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
2. Moderate activities , such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3
3. Climbing several flight of stairs	1	2	3

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health?**

	Yes	No
4. Accomplished less than you would like	1	2
5. Were limited in the kind of work or other activities	1	2

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?

	Yes	No
6. Accomplished less than you would like	1	2
7. Didn't do work or other activities as carefully as usual	1	2

8. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)?

- 1 - Not at all
 - 2 - A little bit
 - 3 - Moderately
 - 4 - Quite a bit
 - 5 - Extremely
-

These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling.

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
9. Have you felt calm and peaceful?	1	2	3	4	5	6
10. Did you have a lot of energy?	1	2	3	4	5	6

6- Self-Efficacy

Self-Efficacy for Exercise scale (SEE)

Participants will rate their confident on the scale between 0-10 and they could complete the exercise components that suggested on the WBI-BACK program if they face obstacles such as pain or depression. Total score is calculated by summing the responses to each question. This scale has a range of total scores from 0-90. A higher score indicates higher self-efficacy for exercise.

	Not very confident										Very confident
<i>How confident are you right now that you could exercise 3 times per week for 20 minutes if:</i>											
1. The weather was bothering you	0	1	2	3	4	5	6	7	8	9	10
2. You were bored by the programme or activity	0	1	2	3	4	5	6	7	8	9	10
3. You felt pain when exercising	0	1	2	3	4	5	6	7	8	9	10
4. You had to exercise alone	0	1	2	3	4	5	6	7	8	9	10
5. You did not enjoy it	0	1	2	3	4	5	6	7	8	9	10
6. You were too busy with other activities	0	1	2	3	4	5	6	7	8	9	10
7. You felt tired	0	1	2	3	4	5	6	7	8	9	10
8. You felt stressed	0	1	2	3	4	5	6	7	8	9	10
9. You felt depressed	0	1	2	3	4	5	6	7	8	9	10

Appendix 7

Questionnaire based on the Technology Acceptance Model (TAM, Davis, 1989)

	Strongly agree	Mostly agree	Don't know	Mostly disagree	Strongly disagree
Perceived Easy to Use WBI-BACK Programme					
1- The WBI-BACK programme was easy to use	1	2	3	4	5
2- The content of WBI-BACK programme was clear and understandable	1	2	3	4	5
3- I found the WBI-BACK programme easy to learn to use to manage my low back pain	1	2	3	4	5
Perceived Usefulness of WBI-BACK Programme					
4-The WBI-BACK programme helped me to self-manage my low back pain	1	2	3	4	5
5- The WBI-BACK programme provided useful and sufficient knowledge to manage my back pain	1	2	3	4	5
6- I would recommend the WBI-BACK programme to others to help self-manage low back pain	1	2	3	4	5
7- Using the WBI-BACK programme helped to improve my job performance	1	2	3	4	5
Attitude to the use of the WBI-BACK programme					
8- I think that using the information in the WBI-BACK programme is a good way to manage my back pain	1	2	3	4	5
9- I think that using the WBI-BACK programme helped me to manage my back pain	1	2	3	4	5
10- I think that using the WBI-BACK programme is enjoyable	1	2	3	4	5
11- I generally have a positive attitude towards using the WBI-BACK programme	1	2	3	4	5

Appendix 8

Self-reported Usage Data

Participants will be asked how many times they used the WBI-BACK intervention programme.

Please, choose one option for each questionnaire item:

1. On average, how many days a week did you access the WBI-BACK programme?

- ☐ 0 day
- ☐ 1 day
- ☐ 2-3 days
- ☐ 4-5 days
- ☐ Everyday

2. On average, how many hours a day did you access the WBI-BACK programme?

- ☐ 0 hour
- ☐ Less than one hour
- ☐ I hour
- ☐ More than I hour

3-Where did you access the WBI-BACK programme?

(You can choose more than one option)

- ☐ At work
- ☐ Home
- ☐ other, please specify

4- Which modules did you access in the WBI-BACK programme?

(You can choose more than one option)

- ☐ Educational Gallery
- ☐ Exercise gallery
- ☐ Physical activity
- ☐ Ergonomics
- ☐ The psychological unit
- ☐ Healthy lifestyles
- ☐ Did not access any modules

Appendix 9

Qualitative Consent Form

CONSENT FORM (One to one interview)

Development and Feasibility Testing of Web Based Intervention for Self Management of Low Back Pain in Nurses. A Mixed Method Study

Name of Researcher: Rana Alduraywish

Supervisors: Dr Paul Hendrick; Dr Holly Blake

Please initial box

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without my medical care or legal rights being affected. I understand that should I withdraw then the information collected so far cannot be erased and that this information may still be used in the project analysis ☐
3. I understand that the interview session will be recorded using audio recorder, and that anonymous direct quotes from the interview may be used in the study reports. ☐
4. I understand that my recorded data during the study as well as the transcripts, may be heard and seen by the individuals named above, I give permission for them to have access these data. ☐
5. I understand that the information collected about me will be used to support other research in the future and may be shared anonymously with other researchers. ☐
6. I agree to take part in the above study ☐

Name of Participant

Date

Signature

Name of Person taking consent

Date

Signature

2 copies: 1 for participant, 1 for the project notes

Appendix 10

Physical Activity Diary Sheet

Participants will be asked to keep a diary of their goals and activities every week. The participants will record the amount of weekly physical activity during the study period (6 weeks) to be collected by the researcher.

Week / Date:

Goals:

1-

2-

3-

Week / Date	Activity	Time spent
<i>Day 1</i>		
<i>Day 2</i>		
<i>Day 3</i>		
<i>Day 4</i>		
<i>Day5</i>		
<i>Day 6</i>		
<i>Day 7</i>		
<i>Total</i>		

Appendix 11

Semi-structured Interview Protocol

Phase	Guide
Aim	To evaluate, explore the acceptability of the Web based Intervention for self-management of low back pain intervention (WBI-BACK) programme among nurses working in Saudi Arabia as well as their perceptions, thoughts and experiences in relation to this program.
Introduction	• Introduce the study, provide the confidentiality statement and state the interview length. • State participants' rights. • Start audio recording.
During the interview	• Obtain Demographic data. • Guide the participant through the study questions. • Clarify each answer by asking sub-questions.
Ending the interview	• Follow up on any issues raised during the interview. • Thank the participant and describe how his/her contribution is valuable to this study. • Reassure the participant of the confidentiality of information. • Turn off the recorder

**Introduction
Warm
up (5 minutes)**

I'd like to start off by thanking you for taking the time to participate today. My name is Rana Alduraywish and I would like to talk with you about your opinions regarding the Web-Based Intervention for Self-Management of Low Back Pain (WBI-BACK) programme. The interview will take approximately 30–60 minutes. I will be recording the session. The information that you provide will be protected to ensure your privacy and confidentiality. Do you have any questions about what I have just explained? Are you willing to participate in this interview? Interview Date _____ Kindly sign the consent form now.

Core Discussion
(20-40 minutes)

1. Age, gender, history of LBP or not.
 2. Do you enjoy using the WBI-BACK intervention?
 3. Do you have access to the WBI-BACK intervention programme for the required 6 weeks period?
 4. How many days in a week do you access this intervention and where?
 5. How many hours in a day do you have access to this intervention program?
 6. Was the WBI-BACK intervention programme easy to use?
 7. Was the WBI-BACK intervention beneficial and easy to understand?
 8. Were the images, videos and interactive elements useful?
 9. Did you find it difficult to move from one module to another?
 10. Do you think that the WBI-BACK intervention has made any difference to your back pain? If so, in what way?
 11. Do you think the WBI-BACK intervention programme has helped you to gain new knowledge about how to cope with your back pain?
 12. Does the WBI-BACK intervention help you to increase your physical activity level? If so, how? What type of activity?
 13. What barriers do you encounter in using the WBI-BACK programme?
 14. Do you think there are any areas where the WBI-BACK intervention programme could be improved?
 15. Would you recommend the WBI-BACK programme in future for self-management of low back pain?
 16. Would you recommend the WBI-Back Intervention to other nurses?
-

Closing
(5 minutes)

17. Is there anything else to you would like to add?

This is the end of the interview. All the information you have provided will be treated confidentially and will be analysed and interpreted to determine whether this digital intervention (WBI-BACK) can be delivered and made acceptable for nurses working in Saudi Arabia. Thank you so much for your time

Appendix 12

Ethical Approval

1- Ethical Approval from the Research Ethics Committee, Faculty of Medicine and Health Science Research Ethics Committee, UoN (Ref: 307-1904)

 University of Nottingham UK CHINA MALAYSIA	Faculty of Medicine & Health Sciences Research Ethics Committee Faculty Hub Room E41, E Floor, Medical School Queen's Medical Centre Campus Nottingham University Hospitals Nottingham, NG7 2UH Email: FMHS-ResearchEthics@nottingham.ac.uk
--	--

14 May 2019

Ms Rana Alduraywish
PhD Student in Health Sciences
c/o Dr Paul Hendrick
Lecturer Physiotherapy
Physiotherapy and Rehabilitation Sciences
Clinical Sciences Building
Nottingham City Hospital Campus
Nottingham University Hospitals
Hucknall Road
Nottingham, NG5 1PS

Dear Ms Alduraywish

Ethics Reference No: 307-1904 – please always quote	
Study Title: Development and Feasibility Testing of Web Based Intervention for Self-Management of Low Back Pain in Nurses. A Mixed Method Study.	
Location of Study: King Fahd Medical City (FFMC), Riyadh, Kingdom of Saudi Arabia.	
Chief Investigator/Supervisor: Dr Paul Hendrick, Lecturer/PG Course Director, Physiotherapy and Rehabilitation Sciences, Dr Holly Blake, Associate Professor of Behavioural Science/Director of Research and Environment, School of Health Sciences.	
Lead Investigators/student: Rana Alduraywish, PhD student Physiotherapy, School of Health Sciences	
Proposed Start Date: 01/08/2019	Proposed End Date: 30/04/2020

The Committee considered this application at its meeting on 18 April 2019 and the following documents were received:

- FMHS REC Application form and supporting documents version 1.0: 15/04/2019.
- Initial letter of allowing access from KFMC Institutional Review Board (IRB) dated 10.03.2019.

These have been reviewed and are satisfactory and the study has been given a favourable opinion.

A favourable opinion has been given on the understanding that:

1. A copy of the letter of approval is submitted from the KFMC IRB for our records.
2. All appropriate ethical and regulatory permissions are respected and followed in accordance with all local laws of the country in which the study is being conducted and those required by the host organisation/s involved.
3. The protocol agreed is followed and the Committee is informed of any changes using a notice of amendment form (please request a form).
4. The Chair is informed of any serious or unexpected event.
5. An End of Project Progress Report is completed and returned when the study has finished (Please request a form).

Yours sincerely



Professor Ravi Mahajan
Chair, Faculty of Medicine & Health Sciences Research Ethics Committee

2- Ethical Approval from the Chairman of The Institutional Review Board (IRB),
KFMC Hospital, Riyadh, KSA

Kingdom of Saudi Arabia
Ministry of Health
King Fahad Medical City
(162)



المملكة العربية السعودية
وزارة الصحة
مدينة الملك فهد الطبية
(١٦٢)

IRB Registration Number with KACST, KSA: H-01-R-012
IRB Registration Number with OHRP/NIH, USA: IRB00010471
Approval Number Federal Wide Assurance NIH, USA: FWA00018774

June 26, 2019

IRB Log Number: 19-336E

Department: External - University of Nottingham- Division of Physiotherapy and Rehabilitation
Category of Approval: EXEMPT

Dear Rana Alduraywish, Dr. Paul Hendrick and Dr. Holly Blake,

I am pleased to inform you that your submission dated June 26, 2019 for the study titled 'Development and Feasibility Testing of Web Based Intervention for Self-Management of Low Back Pain in Nurses. A Mixed Method Study' was reviewed and was approved according to ICH GCP guidelines. Please note that this approval is from the research ethics perspective only. You will still need to get permission from the head of department or unit in KFMC or an external institution to commence data collection.

We wish you well as you proceed with the study and request you to keep the IRB informed of the progress on a regular basis, using the IRB log number shown above.

Please be advised that regulations require that you submit a progress report on your research every 6 months. You are also required to submit any manuscript resulting from this research for approval by IRB before submission to journals for publication.

As a researcher you are required to have current and valid certification on protection human research subjects that can be obtained by taking a short online course at the US NIH site or the Saudi NCBE site followed by a multiple choice test. Please submit your current and valid certificate for our records. Failure to submit this certificate shall a reason for suspension of your research project.

If you have any further questions feel free to contact me.

Sincerely yours,

Prof. Omar H. Kasule

Chairman, Institutional Review Board (IRB)
King Fahad Medical City, Riyadh, KSA
Tel: + 966 1 288 9999 Ext. 26913
E-mail: okasule@kfmc.med.sa



3- Ethical Approval from the Chairperson of the Nursing Research Committee, KFMC Hospital, Riyadh, KSA.



KFMC NURSING RESEARCH COMMITTEE
NURSING RESEARCH APPLICATION FORM

Completed application form and submit it with your proposal to the KFMC Nursing Research Committee.

Principal Investigator: Name: Rana Alduraywish		Email: Dr.rana.ahmed@gmail.com ntxraa@exmail.nottingham.ac.uk	Contact No.: 0552209660	Fax No:
Hospital: Imam Mohammed bin Saud University		Department: College of Medicine	Section: Anatomy and Physiology department.	
Research: Masters Degree ☐ PhD ☒ Institutional study ☐ Other ☐				
Study Title: Development and Feasibility Testing of Web Based Intervention for Self-Management of Low Back Pain in Nurses. A Mixed Method Study.				
Name of department/s where research will be conducted: Nursing department.				

Status of Principal Investigator: DON ☐ NM/HN ☐ Charge Nurse ☐ Nurse Educator ☐ Staff Nurse 1,2,3 ☐ Other: ☒ Physiotherapist, PhD student.			
Co-Investigator(s):	Dr Paul Hendrick	Dr Holly Blake	
Study Supervisor/s:	Dr Paul Hendrick	Dr Holly Blake	
Approval letter from Institution/organization Yes: ☒ No: ☐			
Funding Information:	☒ Extramural	☐ Intramural	☐ No Funding
Funding Source(s):	☒ Government	☐ Industry	☐ Foundation
Study Sponsor:	Yes: ☒ No: ☐	Agency/Sponsor/Program	Ministry of Higher Education
Study Duration: 5 months	Start Date: September 2019	End Date: January 2020	

Study Description: State the objectives, value and necessity of the study. Include reasons why the proposed study should be undertaken in KFMC. _

1. Background

Low Back Pain (LBP) is a medical problem with an on-going substantial health burden on manufacturers, individuals and the community. It has been reported that nurses have a higher prevalence of LBP globally, which is associated with decreased job productivity, greater absence time, disability and functional limitation (Andersen et al., 2012). In the Kingdom of Saudi Arabia (KSA), similar findings indicate high LBP prevalence in nursing which consistent with research conducted in other countries. Thus, prevention and intervention strategies for the management of LBP among nurses in KSA is a priority.

STUDY PURPOSE

The study purpose is to test the feasibility and acceptability of Web based intervention program (WBI-BACK) developed for the prevention and treatment of LBP among a nursing population in the KSA.

2. STUDY OBJECTIVES

1-To determine the feasibility of WBI-BACK including: recruitment of nurses, participant's retention, data completion rate and appropriateness of selected outcome-measures.

2-To determine the acceptability of the WBI-BACK in supporting nurse's use, adherence to the intervention, adverse events and recommended level of physical activity

KFMC



KFMC NURSING RESEARCH COMMITTEE
NURSING RESEARCH APPLICATION FORM

I confirm that the information submitted is true and accurate and I will abide with the requirements set by the KFMC Nursing Research Committee and acknowledge KFMC in my dissertation/thesis publication. I will submit the study findings/results when the study is completed, as well as a copy of any presentation I have done. (You may be asked to present your study results at a Nursing Research Conference).

Rana Alduraywish

Rana

8 / 9 / 2019

Printed Name

Signature

Date

COMMITTEE APPROVAL: ☒ Approved ☐ Not Approved ☐ Minor changes ☐ Major changes

Remarks: Consider the feasibility of the study.
The study involves meeting each participant and getting consent; intervention requires organising workshop, access by the participants the webbased intervention followed by interview with the participants in the phase 2 of the study.
The study requires the full cooperation from the participants and their time and effort.
Consider these aspects and proceed to the study.
Kindly send a feedback on the research process, after the data collection, which can help us in the future studies.

KFMC NURSING RESEARCH COMMITTEE APPROVAL NUMBER: _____

Approved/Not approved by:

Dr. Diana
9/09/2019

Dr. Diana Selvamony Lalithabai
Nurse Educator NED
Badge # 01-4503
Design # 73912

Dr. Diana Selvamony Lalithabai
Chairperson, Nursing Research Committee

Approved/Not approved by:

Mr. Ahmed
9/09/2019

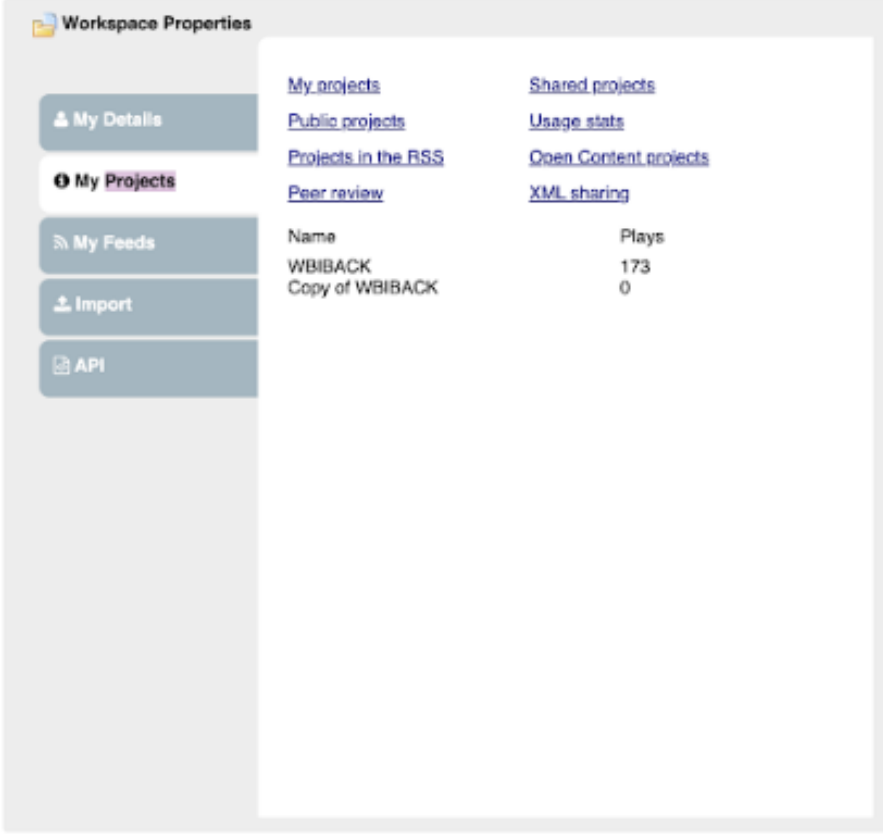
Mr. Khalid Alghamdi
Nurse Educator NED
Badge # 01-4503
Design # 010473

Mr. Ahmed O. Hawsawi
Executive Director of Nursing Affairs

KFMC

Appendix 13

Data Usage of the WBI-BACK Intervention from all participants through the XERET Programme



The screenshot displays the 'Workspace Properties' interface. On the left is a sidebar with navigation options: 'My Details', 'My Projects' (selected), 'My Feeds', 'Import', and 'API'. The main content area is divided into two columns of links at the top: 'My projects' (with sub-links 'Public projects', 'Projects in the RSS', and 'Peer review') and 'Shared projects' (with sub-links 'Usage stats', 'Open Content projects', and 'XML sharing'). Below these links is a table with two columns: 'Name' and 'Plays'.

Name	Plays
WBIBACK	173
Copy of WBIBACK	0

Appendix 14

Normality Test for Outcome Measures

The PR assessed the distribution of the variables by examining statistical tests for normality and used graphical methods to assess changes between pre-and post-intervention scores. These included the scales IPAQ, SF12 and SEE, which both the LBP and NOLBP groups completed. Participants with LBP responded to the following additional questionnaires: the FABQ, NRS, and RMDQ. The change in total scores between the pre- and post-intervention results for all outcome measures in both groups are shown in Table below and in the following figures.

In addition, normality was checked visually via histograms of score changes. This method provided a visual judgment on the gaps in the data, data outliers and data distribution (Ghasemi and Zahediasl, 2012). If scores are skewed to the left or to the right, the variables are possibly not normally distributed. However, Dr. Andrea Venn (University Statistician) agreed that the data from outcome measures questionnaires were normally distributed, and a parametric paired sample t-test was used for analysis on both LBP and NOLBP groups. The figures below provide information on the distribution of score changes in the study outcome variables.

Tests of Normality for Changes in Scores between pre- and post-Intervention

Scales	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	p value	Statistic	df	p value
**IPAQ	.090	45	.200*	.959	45	.114
** (SF12)	.250	45	.000	.870	45	.000
** (MSE)	.127	45	.068	.941	45	.023
*** (FABQ) about physical activity	.139	30	.143	.921	30	.029
*** (FABQ) about work	.174	30	.021	.918	30	.023
*** (NRS)	.227	30	.000	.883	30	.003
*** (RMDQ)	.212	30	.001	.863	30	.001

* This is a lower bound of the true significance.

** (IPAQ): International Physical Activity Questionnaire; (SF12): A 12-Item Short-Form Health Survey; (MSE): Modified Self-Efficacy for Exercise scale. Completed by both groups (LBP and NO LBP).

*** (FABQ): Fear-Avoidance Beliefs Questionnaire; (NRS): Numeric Rating Scale; (RMQ): Roland-Morris Questionnaire. Completed by the LBP group.

a. Lilliefors Significance Correction.

