Factors Associated with Parental and Adult Personal Underestimation of Overweight Status

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Abstract

Parents of children with overweight or obesity often fail to identify their child's weight status. Similarly, adults with overweight or obesity often inaccurately identify their own overweight status. The factors associated with parental and adult personal underestimation of overweight and obesity are still unclear, and they represent the primary focus of this thesis. Study 1 systematically reviews published research to investigate the prevalence of, and factors associated with, the underestimation of children's weight status in parents, healthcare professionals and children themselves. Quantitative and qualitative data were critically reviewed to increase comprehension by exploring any linked factors. It was determined that underestimation of children's overweight is common across a range of nations. With the use of a verbal scale, 55% parents underestimated excess weight and obesity in their children. Use of a visual scale gave rise to a slightly lower, 47% prevalence of underestimation. Children and adolescents also underestimated their own weight status with a prevalence estimate of 34%. HCPs share the same misperception however limited data prevent meta-analysis. Overall, underestimation was positively associated with children's age, gender, child and parent's current weight status, parental educational level and ethnicity. In the qualitative studies, parents commonly describe their children in different terms other than 'obese'. Terms such as "big boned", "thick" and "solid" were used, and demonstrated a strong desire to avoid labelling their child by using medical terminology. Study 2 examines adult personal underestimation of overweight status and the factors associated with this underestimation using quantitative methodology. Among 1061 participants, 43% of participants with overweight and 66% of the participants with obesity underestimated their weight status using a verbal scale, while 29% of participants with overweight and 12% of the participants with obesity underestimated their weight status using a visual scale. Underestimation was associated with gender, age (older

participants), current BMI, and lower educational level. This study contributes to the existing literature on social norms and other psychological factors and suggests that individuals who have high levels of fear of obesity (negative emotions associated with obesity diagnosis) were more likely to underestimate their weight status. In addition, underestimation of overweight and obesity was most common among individuals frequently exposed to obesity in their everyday lives. The findings of study 2 found that participants who selected an overweight silhouette as an average body shape were more likely to underestimate their weight status. In this study, there was a greater accuracy when the visual scale was used compared to a verbal scale. Finally, Study 3 builds on the findings of study 1 and 2 and aims to provide a comprehensive empirical investigation of the relationship between sociodemographic, anthropometric, and psychological factors in adults' underestimation of the overweight and obese status of children. In this questionnaire-based study underestimation of overweight status was associated with child's age, gender, current BMI, parents and grandparents' gender. Further, parents and grandparents who had a high level of negative emotions associated with a child being diagnosed as obese, were more likely to underestimate their child's weight. Finally, high levels of internalised weight bias were associated with higher rates of parental underestimation of child weight. The overall findings of this thesis clearly show that parental and adult personal underestimation of overweight status is widespread. Such under-estimations may significantly delay appropriate interventions to prevent the negative health associated impacts of excessive weight and the thesis identifies urgent need for further research to explore how to overcome the existing barriers towards a more realistic recognition of weight status.

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Dissemination

Conferences

Study 1 included in this thesis has been presented in the 26th *European Congress on Obesity*.

Peer Reviewed Publications

Study 1 in this thesis has been published in an international peer-reviewed journal (Obesity Science and Practice)

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Chapter 1: General Introduction

1.1 Obesity Prevalence

According to the most recent report from the World Health Organization (WHO, 2021), worldwide obesity has risen almost three - fold since 1975. In 2016, 1.9 billion adults have been diagnosed as overweight, 650 million of whom were classified as obese. In the same year, more than 340 million children and adolescents aged 5-19 years were classified as overweightor obese. In 2020, 39 million of children younger than 5 years suffered from overweight or obesity (WHO, 2021).

In most European countries over the past decade, the overall obesity prevalence in adults and children rose from 10% to 40% (Agha *et al.,* 2017). In England, more than a three-fold increase was observed and almost 67% of males and 60% of females and 28% of children aged from 2 - 15 live with overweight or obesity (Agha *et al.,* 2017; National Health Service, 2019).

Although the UK government, from 1992 to 2020 have issued 14 policies and approaches to prevent obesity, the prevalence of obesity has not been reduced and it continues to increase (Theis and White, 2021). Estimates indicate that in 2030, 1.35 billion people will suffer from overweight globally, with a further 573 million being affected by obesity (Mathers and Loncar, 2006).

Overweight and obesity rates are increasing for both sexes and all ages regardless of geographical location, ethnicity, or socioeconomic status. This has been consistent across regions and countries although the absolute prevalence rates vary (Chooi *et al*., 2019). Previously, obesity was considered a health issue only in high income countries but now overweight and obesity are also increasing in low- and middle-income countries, particularly in the urban settings (WHO, 2021). As such, the public health problem of rising levels of overweight and obesity, and especially the emergence of a common condition that was once

relatively rare, has far-reaching consequences.

1.2 Complexity of Obesity

The complexity of obesity is reflected in its diverse and interrelated causes. Obesity results from multiple factors including, genetic (Golden and Kessler, 2020), economic (Finkelstein *et al.,* 2005), psychological (Friedman and Brownell, 2002), cultural (Komesaroff and Thomas, 2007), environmental (Cohen, 2008), and socio-demographic factors (Sung and Etemadifar, 2019). Whatever the cause of obesity, it is strongly implicated in impaired physiological and psychological health both in the short and long term (Schwimmer *et al.,* 2003; Markowitz *et al.,* 2008; De Wit *et al.,* 2010; Luppino *et al.,* 2010). Children with obesity have a higher risk of several diseases compared to healthy-weight children. Table 1.1 summarises many of the complications associated with obesity in children.

Table 1.1 Complications of obesity in Children

Pulmonary	Breathing problems such as asthma (Ross *et al.,* 2012), shortness of breath (Sahoo *et al.,* 2015).
Endocrine	Insulin resistance (Caprio, 2002).
Orthopaedic	Osteoporosis, and joint disorders (Oliveira *et al.,* 2020), conditions which may undermine an children's ability to take part in exercise and physical activity (Daniels, 2006). Degenerative diseases of the knees and other weight-bearing joints, including low back pain, arise as common complications of obesity and overweight, which contribute significantly to absenteeism from school and work (Kafyulilo *et al.,* 2008).

Psychological conditions	Children with overweight/obesity have an elevated susceptibility tolow self-esteem, arising from teasing, bullying, or peer rejection particularlyin the fields of physical activity, sports and friends' engagement (Danielsen *et al.,* 2012). Additionally, childhood obesity has been linked with poor dietary habits and disordered eating symptoms like binge eating, bodyconcerns and dissatisfaction with body image, unhealthy dieting, and other unhealthy weight control approaches (Cena *et al.,* 2017, Goldschmidt *et al.,* 2008), being shy to eat in front of other people, hiding food, eating without feeling hungry (Fiechtner *et al.,* 2018).
Other complications	High cholesterol (LDL) (Moniz *et al.,* 2011), gallbladder disease (Kafyulilo *et al.,* 2008), tallness and sexual maturity often occur sooner in children with overweight/obesity, and in female children with overweight/obesity, irregularity in the menstrual cycle may be observed with potential fertility problems in later life (Alberga *et al.,* 2012).

Various investigations have shown the relationship of paediatric and adult obesity. Children with overweight are more inclined to becoming adults with overweight, particularly at higher BMIs (Guo *et al*., 2002; Simmonds *et al*., 2016) or if they have parent with obesity (Whitaker *et al*., 1997). According to Deshmukh *et al*., (2006), almost 50% of adults with overweight were classified as children with overweight, and over half of the children in the highest BMI quartile are likely to be in the highest BMI quartile as young adults. Adults with overweight or obesity are at a higher risk of numerous diseases compared to healthy-weight adults. Table 1.2 summarises many of the complications associated with obesity in adults.

Table 1.2 Complications of Obesity in Adults

Cardiovascular	Coronary heart disease (Ades *et al.,* 2017), hypertension (Jiang *et al*., 2016), stroke (Katsiki *et al.,* 2011)
Pulmonary	Breathing problems such as asthma (Segula, 2014)
Endocrine	Hypothyroidism (Kokkoris *et al.,* 2003), type 2 diabetes (T2DM) (Adlersberg, 1958)
Gastrointestinal	Gallstones, non-alcoholic fatty liver disease or oesophageal reflux (Camilleri et al., 2017)
Orthopaedic	Osteoarthritis (Lementowski and Zelicof, 2008),
Psychological conditions	Mental illness such as clinical depression, anxiety, and other mental health Quality-of-life, anxiety, low self-esteem and clinical depression (Nigatu *et al.,* 2016)
Other complications	High cholesterol (LDL) (De Vito *et al.,* 2014), dyslipidemia (high triglyceride levels) (Howard *et al.,* 2003), sleep apnea (Itasaka *et al.,*2000), gallbladder disease (Dittrick *et al.,* 2005),

In both children and adults living with overweight or obesity, the COVID-19 pandemic posed further risks, including increased risk of hospitalization with a positive COVID-19 test, advanced treatment needs and increased risk of mortality (Public Health England, 2020; Schuster and de St Maurice, 2021; Theis and White, 2021). In addition to the negative consequences that both adult and children face, the UK Government, (2017) highlighted the financial burden of overweight and obesity on society and the national healthcare infrastructure. In the UK, the broad economic cost of obesity was estimated at approximately £27 billion yearly, with the cost to the NHS being around £6.1 billion.

According to Withrow and Alter, (2011), overweight and obesity the UK may be implicated in 7.6 million disease cases by 2035, which reflects the wider healthcare system problems posed by overweight and obesity. On top of all of this, obesity is a problem with seriously unmet medical needs due to discrepancies between guidelines and the lack of healthcare professionals' clinical training in obesity management (Zelenytė *et al.,* 2021).

Different cut-off values have been used to define overweight and obesity in children and adults around the world. Body mass index (BMI) is the most common index used in the clinical and epidemiological field (Valerio *et al.,* 2017). In children, weight categorisation is based on the child's BMI associated with an age and sex standard (De Onis *et al.,* 2004). A number of BMI cut off values are currently used, including the World Health Organisation (WHO)'s cut off value, which uses Z-scores and standard deviations (SD) that are based on data collected by the organisation from a multi-centre growth reference study (Valerio *et al.,* 2017). The United States Centre for Disease Control and Prevention (CDC, 2000) uses age-sex specific percentiles which are based on data collected from five nationally representative surveys (Kuczmarski *et al.,* 2000). In addition, the International Obesity Task Force (IOTF), is another reference commonly used and which uses sex-specific BMI curves based on data collected from six countries or regions including different nations/ethnicities (Cole and Lobstein, 2012). In adults, BMI is the most common index used for defining weight classification. It is defined as an individual's weight in kilograms divided by the height in square meters (kg/m^2) (WHO, 2021).

In general, diagnostic accuracy of overweight and obesity is a challenge. This is because differences in the diagnostic tools, measurements, terminology, reference standards, and reference levels used in studies of weight and adiposity in children can be difficult, complex and confusing (Flegal *et al.,* 2011). In the UK, different cut-off values are used for clinical use than for surveillance. The National Child Measurement Program (NCMP) measures the heights and weights of all children in reception (age 4–5 years) and year 6 (aged 10–11 years) at state schools in England. Standard population body

mass index (BMI) cut-offs used for NCMP surveillance are the 2nd centile for identifying underweight, 85th centile for overweight, and 95th centile for very overweight (Black *et al.*, 2015). The NCMP uses more strict clinical cut-offs of 2nd centile for identifying underweight, 91st centile for overweight, and 98th centile for very overweight in the report feedback to notify parents (NCMP, 2020; Black *et al.*, 2015). Several studies have criticized the use of Body Mass Index (BMI) as the primary measure of a child's weight in the UK NCMP. For example, Firman *et al.,* 2020 argues that the use of BMI as a diagnostic tool can lead to overdiagnosis and overtreatment of overweight and obesity in children. Furthermore, the study found that the use of BMI as a measure of weight in children can be particularly unreliable, as it does not take into account differences in ethnicity as BMI calculations are exclusively referenced to the White British child growth reference (UK90). Although Firman's study included a large cohort of 38270 children with overweight and obese, the paper lacked methodological detail, author reflexivity and analysis technique.

The use of BMI as a sole measure of obesity is still widely used in other countries such as Canada and the United States, however, recent studies have shown that there is a growing recognition that BMI alone may not be sufficient for identifying children who are at risk for obesity and related health problems. Garnett *et al.*, (2019) highlighted the limitations of using BMI alone as a single measure of obesity in a systematic review of 37 studies that evaluated 53521 children aged between 4 to 18 years. The results of Garnetts' review have shown that BMI alone fail to identify over a quarter of children with excess body fat percentage. Therefore, it seems that although BMI is an important epidemiologic tool to measure to identify population-level risk and track national trends in obesity, however it has limitations in diagnosing obesity at the individual level.

Historically, there has been a great deal of confusion in the literature regarding the lack of strong proof for any one specific definition of overweight and obesity in children (Flegal *et al.,* 2011) and

there remains different cut-offs for population health vs. clinical interventions. Given the importance and the complexity of the obesity problem, developing an accurate method for obesity diagnosis is critical for developing later public health guidelines and treatment interventions, as well as measuring the exact prevalence of overweight and obesity while reducing the associated risk of morbidity in these individuals (Wollner *et al.,* 2017).

1.3 Strategies Used to Track Obesity and the Underestimation of Overweight Status as a challenge in Obesity Prevention

Solving the problem of the rising prevalence of overweight and obesity is complex. This means that a multidimensional approach must be adopted. It is necessary for local and state organisations, policymakers, and other stakeholders to collaborate in such a way as to establish an environment that is supportive to a health-conscious lifestyle. In terms of the otherstakeholders, these include business and community leaders, individuals, and professionals in the areas of education, childcare, and healthcare. Preventing overweight and obesity may involve different approaches for instance dietary, behavioural, pharmacological, physical activity, or surgical intervention (Brauer *et al.,* 2015).

Within the UK context, the latest data from the National Child Measurement Programme (NCMP) for the years 2021-2020 indicate patterns and trends in the prevalence of overweight and obesity among children in reception and Year 6, as well as among different ethnic groups and regions in England. The data reveal that 28% of children aged 4-5 years (reception) are living with overweight or obesity, with 1 in 4 children in this age group falling into this category. This percentage increases to 41% among older children in Year 6 (aged 10-11 years). In terms of ethnicity, the data show that children from Black African and Black other ethnic groups have the highest percentage of overweight or obesity among reception-aged children (23%). However, among older children in Year 6, White and Asian, and Chinese ethnic groups are more likely to be living with obesity compared to White British children. These differences may be attributed to physiological factors such as height and

socioeconomic factors such as area deprivation (Obita *et al.,* 2022). The data also reveal regional variations in the prevalence of obesity, with the highest percentages being found in the West Midlands, London, and Yorkshire and The Humber regions, while the lowest percentages were found in the southeast and southwest of England (NCMP, 2021).

During the last fifteen years in the UK, different strategies have been applied in order to prevent overweight and obesity. In the government publication 'Healthy Weight, Healthy Lives: a Cross-Government Strategy for England' 2008, reducing childhood obesity was a major focus. From 2009-2011, the UK government, launched the Change4life strategy which aimed to encourage a social movement through which government, the NHS, local authorities, businesses, charities, schools, families and community leaders can all play a part in changing behaviour to help improve children's diets and activity levels (Hancock, 2009). The aim was to be achieved by encouraging target audiences to be aware that overweight has long-term health consequences, recognise that their own family could be at risk, and take responsibility for reducing that risk by adopting healthier family behaviours (Croker *et al.,* 2012). The Change4life campaign used a social marketing approach comprising universal and targeted messages, initially, the primary target was families with children aged 0–11years and pregnant women, particularly those from 'at risk' groups. Research has shown that the Change4Life campaign has had some success in increasing awareness of healthy eating and physical activity among the public.

Wrieden *et al.,* 2016 conducted an experimental study on families who had signed up to the 'Change4Life Smart Swaps' campaign (campaign aimed to encourage families to change their food purchases to healthier options like by replacing full fat milk and cheese with low fat milk and cheese and replacing full sugar soft drinks and cereals with reduced- or no-sugar products). Participants were divided in to two groups intervention group (267 families who had signed up to the 'Smart Swaps' campaign promoted through various media, including television and radio advertising) and a

comparison group (135 families resident in Wales, signed up for 'Change4Life' materials, but not directly exposed to the 'Smart Swaps' campaign). When making a purchase within the category, participants were asked to record their purchases of dairy products, carbonated drinks and breakfast cereals, using a mobile phone app questionnaire during the first, second and third weeks of the campaign. Around 55% of adults had heard of the campaign and that it led to an increase in the number of people making healthier food choices. Although, the results of the study were promising, short-term studies such as these do not necessarily show sustained changes over time. However, some studies have highlighted that the campaign has had limited impact on attitudes or behaviours among children. Croker *et al*., (2012) conducted a study that aimed to assess the effectiveness of the Change4Life campaign in promoting healthy eating and physical activity among children aged 5-11 years. The study included 3,774 parents of children from 40 primary schools across England who were randomly assigned to either an intervention or control group. The intervention group received personalised feedback on their children's eating and physical activity habits, while the control group received generic materials. The study found that the Change4Life campaign was associated with a high level of interest and awareness among participants (75-96%), however, few changes were observed in attitudes or behaviours related to healthy eating and physical activity. One limitation of the study is that the sample was primarily composed of families from higher socioeconomic backgrounds, which may not be representative of the target audience for the campaign, as children from lower socioeconomic communities have a higher prevalence of obesity. Additionally, the study's findings may have been more informative if it had focused on a specific aspect of healthy habits, such as physical activity or diet, rather than targeting multiple behaviours. Overall, while the Change4Life campaign has increased awareness of healthy eating and physical activity among the public, it has not been successful in reducing obesity rates among children in the UK. The lack of effectiveness of the campaign may be due to the limited scope of the campaign, which mainly

focuses on promoting healthy lifestyle changes, instead of addressing the underlying socioeconomic and environmental factors that contribute to obesity. It is worth noting that the campaign, although still running, has not been as heavily promoted as it was in its initial phase and has been incorporated in other strategies and campaigns such as Childhood obesity: a plan for action and the more recent One You campaign which focuses on the prevention of obesity and other health related issues in adults.

The childhood obesity plan for action is another policy which was in place from 2016 to 2020 and aimed at tackling childhood obesity by reducing sugar and calorie content in food, promoting healthy food options and physical activity, and providing support for families. (Griffin *et al.,* 2021). One key aspect of the plan was the introduction of the "Sugar Reduction Programme", which set a target to reduce the sugar content in food and drinks by 20% by 2020. The program was designed to help reduce the amount of sugar children consume, and evidence suggests that it has led to a reduction in the sugar content of food and drinks. According to Public Health England, the sugar content of products targeted by the program has fallen by an average of 15% between 2015 and 2018 (Public Health England, 2018). However, the plan has been criticised for not addressing the underlying socioeconomic and environmental factors that contribute to obesity, such as poverty and access to healthy food.

A critical review analysed the English national policy from a social determinants of health perspective using a realist and problem representation approach: the 'Childhood Obesity: a plan for action' (2016, 2018, 2019). Griffin *et al.,* (2021)'s suggested that, the Childhood Obesity Plan for Action has had some success in reducing the sugar and calorie content in food and promoting physical activity, however it has not been as effective in reducing high level of obesity rates among children in the UK. In addition, Griffin *et al.,* (2021)'s argue that the plan does not sufficiently address the social determinants of health and health inequalities. This criticism has also been supported by a mixed

method study conducted by Theis and White, (2021) in a theoretical framework and an intensive applied thematic analysis approach study. The authors analysed 14 government strategies published from 1992 to 2020 containing 689 wide-ranging policies in the UK, it was found that much of the policy activities are heavily focused on individual behavioural level and are proposed with limited guidance on implementation. Despite the fact that the review is a comprehensive and wide-ranging analysis, the authors fail to consider deeper analysis of other important factors of the policies. For example the quality of scientific evidence cited in policy documents and whether or how well policies were implemented. Knowing that these strategies have been introduced during the last 27 years and yet have not reduced obesity rates, more in depth analysis would have been more useful if they had focused on the success or failure of these efforts at policymaking to address this major public health challenge.

Similar to the previously mentioned behaviour change policies, NHS policy across the UK introduced 'Making Every Contact Count' (MECC) as a behaviour change initiative. This initiative was developed by NHS Yorkshire and Humber in response to the publication of the National Institute for Health and Clinical Excellence (NICE) public health guidance document (Parchment *et al.,* 2021). The guidance highlighted the unique position of frontline staff for promoting lifestyle behaviour change and suggested that such health promotion could reduce the burden of non-communicable diseases in the UK (Parchment *et al.,* 2021). In a scoping review of the literature on MECC, Parchment *et al.,* (2021) provide an overview on the perceptions and impact of Making Every Contact Count policy. After reviewing 22 articles, it was found that interventions that used Making Every Contact Count approaches were associated with small increases in physical activity, healthy eating, and smoking cessation. However, it is important to note that the evidence for MECC is still limited. Many of the studies that have been conducted on the approach have been small, and the results have been mixed (Bancroft., 2019; Tucker., 2019 and Chisholm et al. 2020). Additionally, it is difficult to determine the

specific components of MECC interventions that are most effective, and there is a lack of long-term follow-up data to assess the sustainability of the changes in behavior that are observed (Parchment *et al.,* (2021).

Behavioural interventions targeting changes in physical activity and diet are the basis of interventions for the management of overweight and obesity (Cradock *et al.,* 2017). In order to enact behavioural change, individuals with overweight and obesity have to be aware of their weight status and be better able to manage their weight or their child's weight. For instance, physicians in both the UK and the USA are encouraged to screen and inform their patients about their weight status (Haynes *et al.,* 2018). Since 2006, the UK government has launched the NCMP, which monitors and notifies parents of their child's weight. Before taking child's measurement by school nurses, parents receive an information letter about the importance of the NCMP, providing a chance to opt their child out of the measurements. Although the NCMP is intended as a surveillance programme, in most local authorities it is also used to recognise children who are above a healthy weight for their height in order to make parents informed of this and offer advice or support for weight management (Kovacs *et al*., 2018). The importance of this programme lies in assessing overweight and obesity levels by measuring the weight and height of the child during reception (aged 4 to 5 years) and year 6 (aged 10 to 11 years). The data obtained from this program services determine what interventions are required to prevent and treat obesity in these age groups as well as monitoring the success of any interventions (NCMP, 2020). Many USA States have used a similar school health screening programme (Haynes *et al.,* 2018). However, such weight feedback letters and the NCMP as a whole have been met with mixed reactions from parents. Some studies suggests that the letter is useful in raising awareness of excess weight and that most parents agree with the feedback and find it effective and helpful (Mooney *et al.,* 2010). Conversely, other studies report that some parents feel upset and distressed on receiving the letter, particularly if it states that their child is overweight or

obese (Park *et al.,* 2014). However, even among those parents who report that the feedback letter is helpful, few intended to change their child or family's lifestyle after knowing their child is with overweight (Park *et al.,* 2014; Mooney *et al.,* 2010).

Although, the need for weight management and monitoring, education around health and providing advice for both adult and children and their parents about weight, nutrition behaviour and lifestyle is well recognized, many international reports have indicated that a considerable percentage of healthcare professionals are uncomfortable with talking about weight issues and weight management and view these conversations as "difficult" and, as a result, neglect to focus on the subject (Steele *et al.,* 2011; Johnson *et al.,* 2018). The reasons for this include the cultural sensitivity of the topic, fear of encouraging eating disorders or doing psychological harm, worries about the cut-off points, an absence of communication skills about weight and or worries about what to recommend to caregivers as the best approaches to use when talking to the children about weight related problems as well as underestimation of overweight status (Ikeda *et al.,* 2006; Howe *et al.,* 2017).

The first step in treating obesity is to diagnose it and to clearly communicate the diagnosis withthe individual or the child's parents (Bleich *et al.,* 2011). The healthcare professionals and patient relationships in treating obesity are essential but also complex. Based on the studies examining behavioural change, it is reported that patients often go through precontemplation and contemplation stages (Bleich *et al.,* 2011). Patients are more likely to move from precontemplation to contemplation and even from the contemplation stage to the action stage if the pros are increased and the cons are decreased. These pros can be increased if thehealthcare professional addresses weight perception as a key health issue (Bleich *et al.,* 2011). Exploring such perceptions should include both the awareness of weight issues and the readiness for change (Bertakis and Azari, 2005). However, this situation may be threatened by misaligned weight perceptions. Extensive research indicates that underestimation of overweight status is common among large numbers of parents of

children with overweight orobesity, a substantial proportion of adults with overweight or obesity, lay people and medicalpractitioners, when identifying overweight and obesity in self and others (Yaemsiri *et al.,* 2011;Lundahl *et al.,* 2014; Tarasenko *et al.,* 2014). This overweight underestimation may undermineinterventions to achieve a healthy weight and may act as a barrier for lifestyle changes (Zelenytė *et al.,* 2021). The factors leading to this underestimation remain unclear. Hence the importance of this study. This next section will first summarise evidence for the underestimation of overweight and obesity by drawing on research on self and parental underestimation of overweight status. This is followed by a literature review that considers theavailable evidence on the factors associated with this underestimation.

1.3.1 Parental Underestimation

Underestimation of the overweight status of a child by their parent refers to a situation where the parents view a child with overweight or obesity as having a 'normal' or being in a healthy weight range (Robinson, 2017). The phenomenon has been measured in the previous studies by using both verbal and visual scales. Verbal scales involve multiple-choice questions based on weight/BMI categories and parental weight perceptions in relation to their child (Baughcum *et al.,* 2000; Myers and Vargus, 2000; Young-Hyman *et al.,* 2000; Maynard *et al.,* 2003; Reifsnider *et al.,* 2006; He and Evans, 2007), whereas visual scales involve selecting from images or silhouettes, where the parent is blind to the BMI or verbal weight status categories (Lazzeri *et al.,* 2006; Chaimovitz *et al.,* 2008; Moschonis *et al.,* 2011).

The substantial literature on the underestimation of overweight status by parents consistently suggests that parents of children with overweight or obesity are inaccurate in recognizing the status of their children (Jeffery *et al.,* 2005; Miller *et al.,* 2007; Parry *et al.,* 2008; Ali *et al.,* 2011; Hearst *et al.,* 2011; Jones *et al.,* 2011; Rietmeijer-Mentink *et al.,* 2013; Lundahl *et al.,* 2014; Katz, 2015). In Lundahl *et al.,*'s (2014) meta-analysis, including more than 15,000 parents, overweight and obesity

was underestimated by 51% of the parents. The systematic reviews by Parry *et al.,* (2008) and Rietmeijer-Mentink *et al.,* (2013) reported consistent findings, indicating that between 50% and 60% of parents underestimate childhood overweight and obesity. These systematic reviews included studies up to 2014 and it is unknown whether there have been any changes in parental views regarding their children's weight status, given the current significant attention paid to the treatment and prevention of overweight and obesity globally.

1.3.2 Adult underestimation of their own overweight status

Weight status underestimation, in adult personal evaluation, refers to misconceptions of one's own weight as healthy (Robinson, 2017). Weight status perception in adults can also be assessed using a verbal or a visual scale. In verbal scales, respondents are asked to complete multiple-choice questions where the response categories are determined by medical weight standards (Yaemsiri *et al.,* 2011). By contrast, in visual scales, respondents choose images from silhouettes or pictures that are not explicitly associated with BMI and weight status categories (Maximova *et al.,* 2008).

Researchers from multiple disciplines have long examined the underestimation of overweight status. In a 2013 study, the researchers drew on data obtained from a representative survey of UK participants, where 31% of overweight adult women and 55% of overweight adult men underestimated their overweight status (Robinson and Oldham, 2016). Yaemsiri *et al.*'s (2011) study of 16,000 US residents, representative of the national population, indicated similar findings, with 23% and 48% of overweight adult women and men, respectively, underestimating their weight status. However, the two previously mentioned studies have reported adult perceptions of weight status using the verbal scales only, and it may have been more informative if they also used visual assessment methods.

Using visual scales, consistent personal weight underestimation in individuals has been reported in

the literature. For example, del Mar Bibiloni *et al.,* (2017) used the Stunkard Body Rating Scale (Stunkard *et al.,* 1983) to measure weight status perception based on 9 female or male silhouettes ranging from underweight to obese. The respondents chose the silhouette they considered most representative of their body, which was comparatively examined against the medical weight standard of BMI. About one third of participants with overweight/ obesity had underestimated their weight status. In summary, data from several studies suggest that there is an increasing rate of adult personal underestimation of overweight and obesity which may delay weight management and intervention efforts (Burke *et al.,* 2010; Ali *et al.,* 2011; Duncan *et al.,* 2011; Andrade *et al.,* 2012).

1.4 Factors associated with underestimation of overweight status

The related factors that determine why parents /adults underestimate their own weight status, or that of their children, are still unclear (Foster and Hale, 2015; Robinson, 2017). Recent literature has reported mixed results to explain how different anthropometric, sociodemographic, cognitive and social factors, predict underestimation of overweight status. Extensive research has shown that underestimation of child's overweight appears to be particularly pronounced for younger children (2-5 years old) compared to older children (West *et al.,* 2008; Rietmeijer-Mentink *et al.,* 2013; Lundahl *et al.,* 2014). However, Abbott *et al.,* (2010) and Black *et al.,* (2015) note that such parental underestimations of obesity also apply to adolescents and children over 5 years of age, where over a third of parents demonstrate underestimation to said age groups. Furthermore, in line with research on parental weight underestimation, there is evidence that adult personal underestimation could be affected by age. Older adults with overweight or obesity are more likely to underestimate their weight status than younger adults (Kim *et al.,* 2008; Bhanji *et al.,* 2011). In addition, girls were less likely to have their weight underestimated than boys (Baughcum *et al.,* 2000; Boutelle *et al.,* 2004; Adams *et al.,* 2005; Genovesi *et al.,* 2005; Rhee *et al.,* 2005; Fisher *et al.,* 2006; He and Evans, 2007; West *et al.,* 2008; De La *et al.,* 2009; Vuorela *et al.,* 2010; Webber *et al.,* 2010; Hearst *et al.,* 2011; Jones *et al.,*

2011). However, in line with the findings of a 2009 review, research suggested that the classification of child weight status by parents was not impacted by gender following a review of nine studies out of 17 (Towns and D'Auria, 2009). In adult personal weight perceptions, previous studies show gender discrepancies in underestimation of weight status with the majority of evidence suggesting that underestimation of overweight status is particularly pronounced for males than females (Chang and Christakis, 2003; Oldham and Robinson, 2016).

A correlation between the maternal level of education and underestimation of children's overweight status was found to be non-existent by various academic works (Adams *et al.,* 2005; Carnell *et al.,* 2005; He and Evans, 2007; Hearst *et al.,* 2011). However, others propose that parents with lower educational levels are more likely to underestimate their children's weight (Maynard *et al.,* 2003; Kroke *et al.,* 2006; de Hoog *et al.,* 2012; Rodrigues *et al.,* 2020). Conversely, the underestimation of their child's weight status was discovered to be more probable in parents who have high levels of education (Ruiter *et al.,* 2020). Although relatively few studies examined the association between adult personal underestimation of own overweight status and educational level, Ver Ploeg *et al.,* (2008) and Fang *et al.,* (2018) found that lower educational level was significantly associated with the likelihood of underestimation in adults. Further studies are needed to investigate this relationship.

The underestimation of overweight seems to be particularly pronounced among children and adults whose BMI falls in the overweight category rather than the obese category. Miller *et al.,* (2007); Lundahl *et al.,* (2014) and Black *et al.,* (2015) state that the children whose weight is in the overweight category are most frequently underestimated. The personal weight evaluation of adults suggests equivalent findings. Johnson *et al.,* (2008) notes that adults in the upper end of the overweight range, between >25 to 29.9 BMI, are less likely to underestimate their weight status. However, Johnson *et al.,* (2008) stress that the misperception of weight status still occurs frequently in adults lying within the upper

limits of the BMI overweight range. Nevertheless, the correlation between the underestimation of a child's weight and the weight status of parents was found to be non-existent in a separate study (Linchey *et al.,* 2019). Earlier publications examining the influence of race/ethnicity on underestimation have been mixed in their conclusions. West *et al.,* (2008) and Twarog *et al.,* (2016) demonstrate how the underestimation of the overweight status of children was positively correlated to Hispanic and African American ethnicity. However, the accuracy of parental perceptions of their adolescents' weight status was significantly associated with ethnicity in a study by Boutelle *et al.,* (2004). In this study, Asian, white, and African-American parents were more likely to have an accurate estimation of their teens weight than Hispanic parents. Similarly, in adults, a large multi-ethnic urban cohort study by Powell *et al.,* (2010) demonstrated that underestimation of overweight status was common among participants who were African American. In addition, underestimation of overweight status was more common among Black and Hispanic individuals than Whites (Paeratakul *et al.,* 2002; Dorsey *et al.,* 2009). Cultural acceptance of larger body sizes in some ethnicities may be responsible for this tendency to underestimate overweight status (Naigaga *et al.,* 2018).

Recent studies have highlighted the need to take into account the cultural context in which perceptions of weight are formed, as cultural beliefs and norms can influence how individuals perceive and respond to their weight status (Soh, et al., 2020). Several studies examined the influence of cultural preferences regarding body weight on body weight perceptions. Acceptance of larger body size particularly in populations living in obesogenic environments can hinder individuals' readiness to lose weight (Puoane *et al.,* 2011), thereby increasing desirability to keep larger bodies. In some cultures, rooted values around large body sizes are exemplified as strength, beauty, sexual desirability, health, happiness, wealth, success and affluence (Bosire *et al.,* 2020). This is exemplified in the work undertaken by Lynch *et al*., (2014). In their study, 25 African American women were interviewed and guided by a cognitive mapping exercise in order to explore specific cultural factors that impact their body size ideals. The

findings of this study suggested that among African American women, there was a positive cultural norm associated with having a larger body size, and these women were more likely to underestimate their weight status. Despite the fact that this study has a clearly described methodology, the sample for this study was smaller than other mixed methods and qualitative studies that have been conducted to assess body size ideals among African American women (Pickett, S. and Peters., 2017; Cameron *et al*, 2018).

Accurate perception of body weight is considered an important motivation for taking action and engaging in healthy lifestyle behaviours. Yet, differences in perceptions of body size or weight, largely influenced by socio-cultural factors have the ability to influence weight preference (Haynes *et al.,* 2018). Beside these demographic and anthropometric factors, previous literature has also proposed other psychological and social norm factors that may influence weight status misperception. For example, with the dramatic increase of obesity in the community today, being overweight has gained recognition as being an accepted novel standard, as per the findings on emerging social norms (Robinson, 2017). Robinson's visual normalization theory indicates that individuals evaluate their weight against the body sizes they have previously seen. This suggests that when large body sizes become more common in any society, this emerges as the new standard.

In a qualitative study examining the way parents of children with overweight/obesity assess child weight status, further reinforcement was added to a normalization theory of weight status underestimation. Jones *et al.,* (2011) examined weight perceptions of 536 parents in a Gateshead Millennium Study children. Parents' perception of their child's weight status was rated using the question 'How would you describe your child's weight at the moment?' and using the question 'How can overweight children be identified?' to explore their perceptions about the approaches to identifying overweight children. During discussions a common approach used by parents was to compare children

with other children they had been exposed to. The findings indicate, therefore, that a parent's ability to detect overweight or obesity in their child is influenced by surrounding factors such as social norms, and thus may be inaccurate compared to medical classifications of overweight and obesity. Substantial evidence suggests that parents regularly fail to accurately identify child as overweight until the weight of their child becomes extreme (Lundahl *et al.,* 2014). An example of this is the research carried out by Johnson *et al.,* (2008), where self-perceptions of overweight and obesity from 1999 to 2007 in a sample of adults from the UK were studied. They reported that the average weight increased over the period of study, and the proportion of weight status underestimation also increased. Findings that are similar in a conceptual sense were published by Burke *et al.,* (2010) in a sample of US residents. Between 1988 and 2004, the average weight increased significantly and rapidly in the US, and the underestimation of overweight or obese status also grew. In parents, overweight underestimation in children also increased with the growth of childhood overweight and obesity (Robinson *et al*.,2017). Accurate weight assessments in parents reduced by 30% between 1994 and 2007, in line with the growth in the number of children classified as overweight or obese (Duncan *et al.,* 2015). This trend is consistent with Hansen *et al.,* (2014)'s findings where data from NHANES 1988-1994 (n = 2871) and 2005-2010 (n = 3202) cohorts were used for analysis. Parents, mainly mothers, were asked whether they considered their child, ages 6 to 11 years, to be overweight, underweight, or just about the right weight to assess the generational shifting of parental perceptions about children's weight during this period. The findings indicated that parents were characterized by a 24% lower probability of recognizing their child's overweight status correctly in 2005 compared to 1995. In the same way Robinson and Hogenkamp, (2015) focused on the general recognition of overweight and obesity and examined 553 male and female online from three countries (US, high obesity prevalence; UK and Sweden, lower obesity prevalence). Participants were asked to select the weight status of a series of photographed healthy weight, overweight and obese (class I) and rate the extent to which they believed each should consider

losing weight. It was found that underestimation of weight status tended to be lower when national obesity prevalence was lower. One potential concern of Robinson and Hogenkamp, (2015)'s study is that almost all the sample were mainly from high socio-economic status, compared to the general population given some research suggests that socioeconomic status is associated with differences in perceptions of ideal body size (von Lengerke *et al.*, 2012).

In a similar manner, Robinson *et al.,* (2014) investigated the impact that visual exposure to various weight statuses had on the identification of overweight and obesity. The respondents viewed 10 images of men with either a healthy BMI or obese BMI. In turn, the respondents were asked to judge for overweight or obesity in the images. The results indicated that the respondents who had previously been exposed to obesity or overweight in males had a higher likelihood of rating an unhealthy weight as a healthy one as well as more attractive. Robinson *et al.,* 2014's research indicates that the question of whether one has been exposed to overweight and obesity influences the underestimation of these conditions. While this is clear, however, it remains unclear if these visual-norm explanations are also linked with adult personal and parental underestimation of overweight because these previous studies have focused on judgements that were made about unknown others. The extent to which these visual norm explanations are applied to personal and parental underestimation of overweight will be explored in this thesis.

The influence arising from weight stigma has not been examined to an adequate extent in the literature. The terms 'overweight' and 'obese' are associated with significant stigma and are frequently regarded in a negative way (Hirschfeld-Dicker *et al.,* 2019). Such medicalised terms may also influence patients' perceptions of obesity. Robinson and Hogenkamp, (2015) suggest that the accuracy of weight status estimation may be influenced by the stigma surrounding overweight and obesity, and in particular the individual's desire to safeguard against discrimination. In a scoping review by McPherson *et al.,* (2016),

it was found that parents who had previous experience of weight-related stigma consciously steered their children away from childhood or adolescent obesity diagnoses to protect them. Therefore, among people who realise that they are suffering from overweight or obesity, the issue of whether to acknowledge this and become a member of a stigmatized group in society is complex. The stigma can affect self-worth and levels of stress, exacerbating the already unfavourable impacts of overweight and obesity. Preventing it from being recognized may improve the individual's well-being. However, currently, there are no data on the association between the negative emotion associated with obesity diagnosis and parental and adult personal underestimation of overweight status and this potential association is investigated in studies 2 and 3 presented in the current thesis.

The experimental data are rather controversial, and there is no general agreement about why underestimation of overweight status occurs. Explanations for the discrepancy between studies could be explained by the difference in the age range of the participants involved, the different BMI cut-off references used to define overweight, and obesity, the sample size of the study population, and the choice of the subgroup analysis performed. In addition, there is no insight into changes in perceptions of weight status over time (Ruiter *et al.,* 2020). Furthermore, far too little attention has been paid to the influence of using different methods of measuring weight perception on the underestimation of overweight status. The exploration of the use of different methods (verbal vs. visual) with the same sample is necessary and may help explain inconsistent results.

1.5 Thesis Overview and Aims

Healthcare professionals are in a prime position to identify body weight issues. Research indicates that a good relationship between healthcare professionals and patients may lead to better weight management (Huang *et al*., 2004; Loureiro and Nayga, 2006; Kant and Miner, 2007; Pollak *et al*., 2010). Although effective healthcare provider-patient communication is a cornerstone of patient adherence

and compliance, (Labrie and Schulz, 2014; Hesse and Rauscher, 2019), this relationship may be threatened by misaligned perceptions of the situation. Underestimation of overweight status is increasingly being recognised as one of the key challenges to the treatment and prevention of obesity and is a new potential target in the obesity treatment paradigm (Powell *et al*., 2010). Recent literature to date demonstrates that many parents of children with overweight or obesity (Parry *et al*., 2008; Lundahl *et al*., 2014), adults with overweight or obesity (Kuchler and Variyam, 2003; Yaemsiri *et al*., 2010; Johnson *et al*., 2014) and healthcare professionals (Bramlage *et al*., 2004; Smith *et al*., 2008) underestimate overweight status. The reason why the underestimation of overweight status frequently occurs is not yet clear. Therefore, this thesis aimed at investigating the factors associated with overweight underestimation in parental and adult personal evaluation.

In order to explore these factors, study 1 intends to statistically determine the extent to which underestimation of a child's overweight status is prevalent among children, parents and healthcare professionals. In addition, this systematic review and meta-analysis has aimed to critically synthesise both quantitative and qualitative evidence to extend the findings by investigating the factors associated with this underestimation. Part of the aim of this systematic review is to examine the effect of the diversity of the methods used to assess this phenomenon in the relevant evidence.

In line with parental underestimation of child overweight, study 2, empirically explores demographic, anthropometric and psychological factors associated with underestimation of overweight status in personal evaluation and contributes to the existing literature on social norms and investigates the association between fear of obesity diagnosis and underestimation of overweight and obesity. The impact of obesity exposure on the underestimation of overweight status and perceptions regarding an average body size were also explored. In chapter 4, study 3 builds on the findings presented in chapters 2 and 3 and aimed to provide a comprehensive empirical investigation of the relationship between

sociodemographic, anthropometric, and psychological factors in adults' underestimation of overweight and obese weight status of children. The influence of different methods measuring weight perception on the underestimation of overweight status (verbal vs. visual) were examined in all the three studies.

Chapter 2: Underestimation of Weight Status in Children and Adolescents Aged 0 - 19: A Systematic review and Meta-analysis

2.1 Introduction

An increasing number of children worldwide can be classified as overweight and obese. The first step in any treatment is to categorize and identify bodyweight. However, it is generally accepted that a significant barrier to intervention is that the parents of children with obesity underestimate their child's weight status (Ruiter *et al*., 2020). Furthermore, there is some limited evidence that children themselves and healthcare professionals may also underestimate (Chaimovitz *et al*., 2008). It is unclear why underestimation occurs.

Earlier reviews in this area have solely focused on parental perceptions towards child weight and they have repeatedly demonstrated that 50-60% of parents tend to underestimate their children's weight (Parry *et al*., 2008; Doolen *et al*., 2009; Rietmeijer-Mentink *et al*., 2013). The most recent meta-analysis included over 15,000 parents and searched databases up to 2014, reporting that 51% of parents underestimate their children's weight if they are with overweight or obesity (Lundahl *et al*., 2014). However, it is still unclear whether there has been any changes in parental views of their children's weight status, given the significant attention to the treatment and prevention plans of overweight and obesity globally.

In the area of the prevention and treatment of childhood obesity and in order to enact behavioural change, it is important to achieve concordance and explore the perceptions of the therapeutic triad which involve, the child (if sufficient cognitive capacity), their parents, and the healthcare professionals. Effective weight control interventions for children are strongly informed by the degree to which the overweight and obesity perceptions of children, parents and healthcare professionals are accurate and consistent with one another (Tarasenko *et al*., 2014).

In-depth engagement and cooperation across the therapeutic triad is required for concordance, a dynamic which would be threatened by misaligned perceptions of the situation (Tarasenko *et al*., 2014). The psychological resistance that sometimes arises in parents due to the perceived link between childhood obesity, stigma, and blame, may result in their denial of a healthcare professionals' diagnoses, which decreases their receptiveness to the proposed interventions (Atlantis and Ball, 2008; Puhl *et al*., 2010).

Data from several studies suggest that negative emotions like anger and shame may lead to resistance in the form of refusing to take advice or ignoring referral appointments. Previous research has demonstrated that healthcare professionals can perceive conversations around weight to be 'difficult' and thus avoid raising the subject at all (Johnson *et al*., 2018). Effective communication is the basis for therapeutic relationships in health care (Windover *et al*., 2014) and can affect health outcomes positively (Street *et al*., 2009). Understanding how sociodemographic, anthropometric and cognitive factors, that may influence underestimation, may help to pre-empt these 'difficult' conversations, facilitating the recognition of children's overweight status, unifying the therapeutic triad and helping to inform improvements for future weight-related communications.

The current systematic review and meta-analysis seeks to update our knowledge by statistically identifying the prevalence of the underestimation of children's overweight status in children aged ≤19 years old in a wider sample of parents, the children themselves and the healthcare professionals. In addition, this review aims to critically synthesise both quantitative and qualitative evidence to extend our understanding by investigating the factors associated with this underestimation. The systematic review also examines the diversity of methods used to assess this phenomenon.

Objectives of this chapter are:

1- To systematically identify, extract and critically appraise relevant research meant to investigate the prevalence of, and factors associated with, the underestimation of children's weight status in parents, healthcare professionals and the children themselves.
2- To critically synthesise both quantitative and qualitative evidence to extend our understanding by investigating the factors associated with this underestimation.
3- To examine the diversity of methods used to assess this phenomenon (e.g. verbal scalevs. visual scale).

The study described in this Chapter has been published in a peer reviewed Journal

Alshahrani A, Shuweihdi F, Swift J, Avery A. (2021). Underestimation of Weight Status in Children and Adolescents Aged 0-19: A Systematic review and Meta-analysis. *Obesity science and practice journal*.

2.2 Methodology

The current study systematically collected relevant literature using the following search engines: CINAHL, EMBASE, PUBMED, and Psych-Info from 1st January 2000 to 30th December 2020. Studies eligible for inclusion were qualitative and quantitative research papers that included children aged ≤ 19 years. In addition, the studies were also eligible for inclusion if they assessed parents/main carers, children and healthcare professional's perceptions of children's weight using both a verbal scale (e.g. asking participants to complete a forced-choice rating scale whereby each response category was based on a medical weight standard) or a visual scale (e.g. selecting an image from a range of pictures or silhouettes (linked blind to BMI and weight status) that best represented the child's current size. The purposefully inclusive search terms (there is no standard terminology used in the literature) were 'parents/main carers, child, healthcare professionals, overweight, obesity, weight, and

underestimations.' Boolean operators were used to group the terms (see Table 2.1), thereby facilitating a more wide-ranging search. In addition, a reference list of the identified literature was then hand-searched and the 'Cited by' and 'Related Articles' functions in the search databases were also used to retrieve further relevant articles. Publication language and location had no bearing on the nature of the included studies. The participants were the parents/main carers of children with overweight/obesity, children with overweight/obesity or healthcare professionals. It should be noted that data were only based on parents/main carers' assessments of their own children and not assessments of other children. Similarly, the children's assessments were of themselves and not other children, whereas the healthcare professionals' assessment was generalised. Exclusion criteria included studies that do not provide anthropometric measurements with which to compare perceptions, as well as studies focused on perceptions towards 'underweight' or 'normal weight' participants only.

Table 2.1 Search terms used.

The following phrases were altered to meet the search requirements of each single database AND			
OR	OR	OR	OR
Parent* Carer*	Perception* Underestimation*	Weight 'OverWeight'	Child* Adolescents*
Guardian* Caregiver* Mother* Maternal Father* Paternal parent* Family grandparent*	Underdetection* Belief* Recognition* View* Attitude* Perspective*	'BodyWeight' 'OverWeight' 'BodyWeight' Obese*	Children Infant* Youth Healthcare Professionals Physicians Healthcare Provider

Systematic Review Registration

The protocol has been registered at the International Prospective Register of Systematic Reviews (PROSPERO; registration number: CRD42018085823).

Quality Assessment

A modified Newcastle-Ottawa Scale adapted for single use in a specific context (Bawor *et al.*, 2014) was used to assess the quality of the 91 included studies. Following the authors' guidelines each study was assessed on the following criteria: methods used to select participants (i.e. sampling bias), methods used for controlling confounding (i.e. performance bias), statistical methodology (i.e. detection bias) and the methods used to measure the outcome variables are (i.e. information bias). This scale is meant to measure the risk on a scale of 0 (high risk of bias) to 3 (low risk of bias).

Statistical Methods

After the extraction of the quantitative data, the main effect sizes for the percentage of underestimation by parents/main carers and children using both visual and verbal scales were determined using STATA 14 and a meta-analysis was performed using the *R* program. There was insufficient data to consider underestimation in healthcare professionals. For each study,the effect size was calculated for the reported adjusted proportion of the participants who underestimated children's overweight weight status. A random-effects meta-analysis model was used in the study since the studies stem from different populations and design-related heterogeneity (Borenstein *et al.*, 2021). To test heterogeneity between-studies, the χ^2 with a statistic *Q* was used to examine the null hypothesis that all studies have the same true effect, (Hedges,1982) namely H0: $\tau_2 = 0$. Given that the *Q*-test sometimes may fail to detect heterogeneity when the number of samples is small (i.e. less than 10), (Huedo *et al.*, 2006) thestatistics model I_2 was also used to assess the proportion of the observed heterogeneity, (Higgins *et al.*, 2003) as it is not affected by sample size. I_2 values range from

0% to 100% withthree levels of I_2: low, moderate, and high corresponding to values of 25%, 50%, and 75% (Huedo *et al*., 2006). In addition, the 95% CI around the I_2 statistic was also calculated to determine whether the heterogeneity is present. Overall, τ_2, *Q*-test and I_2 were used in this research to decide whether the estimated effects are homogeneous. Thereafter, pooled effect sizes were estimated via random effects models, since the studies are based on different populations. To visualise the overall estimates of the study effects with corresponding confidence intervals, forest plots were used (Lewis *et al*., 2001).

Sensitivity analyses of the meta-analyses were conducted using a range of visual approaches including difference in values (DFFITS), Cook's distances, studentised deleted residuals, Cov- ratios and estimates of heterogeneity. This identified some potentially outlying studies, but

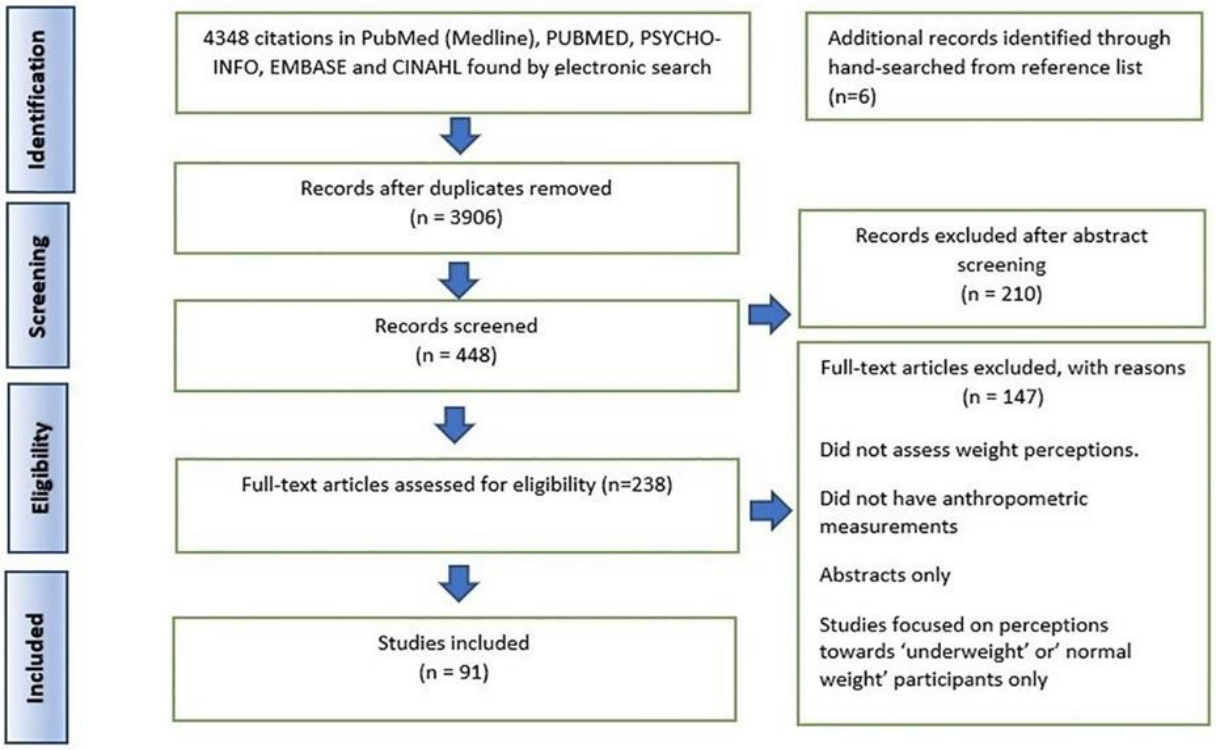
with a low impact on overall estimate sizes, therefore they were retained in the meta-analysis.In evaluating heterogeneity among the studies, it was apparent that there was a significant influence in all datasets, therefore random effects models were applied to all studies.

2.3 Results

Literature Search

A total of 4348 citations of potentially relevant references were identified with 3906 excludedafter title screening. After an abstract and full text screening, a further 357 records were excluded. The reasons for the exclusions included lack of anthropometric measurements (n = 67), an absence of an assessment of weight perceptions (n = 58) and abstracts only (n = 22). After the exclusions, 91 studies fulfilling the inclusion criteria were included. Figure 2.1 depictsthe results of the search strategy based on the PRISMA checklist (Moher *et al*., 2009).

Figure 2.1 PRISMA flow diagram of the search strategy



Study Selection and Characteristics

Table 2.2 shows the included studies (n = 91). The majority were quantitative, non- experimental, cross-sectional studies (n = 88), while a relatively small number (n=3) were either qualitative only (Redsell *et al*., 2010; Eli *et al*., 2014) or mixed methods (Thompson *et al*., 2014).Verbal scales alone were used in the majority of the studies (n = 76), while visual scales alone were employed in eight studies, five of which applied both verbal and visual scaling (Eckstein *et al*., 2006; Lazzeri *et al*., 2006; Spurrier *et al*., 2006; Chaimovitz *et al*., 2008; Moschonis *et al*.,2011). The studies were conducted across 20 different countries; 50% were conducted in European countries, 41% in the United States of America, 9% across Asia. All the included studies were in the English language and involved 24,774 participants- children, parents/main-carers and healthcare professionals. While (n=29) studies did not report on ethnicity, the ethnic group that appeared with the greatest frequency across the studies were Hispanic, African American, White, Native American, and Asian. In terms of weight

status, the majority of the studies included children ranging from all weight categories (n = 82), while for 6 studies,most children were classified as either overweight or obese (Jackson *et al.*,1990; Myers *et al*., 2000; Young-Hyman *et al*., 2000; Fisher *et al*., 2002; Krok *et al*., 2006; Hackie *et al*., 2007; Rudolph *et al*., 2007;Maximova *et al*., 2008; Al-Qaoud *et al*., 2010; Perrin *et al*., 2010; Lydecker*et al*., 2016; Twarog *et al*., 2016).

Data Extraction

Table 2.2 shows the summary characteristics of 91 studies included in this review. Data was extracted based on the study characteristics. These included authors/date, country and ethnicbackground, total number of participants, age of children and adolescents, sampling and recruitment; setting, respondents who provided the data, the overweight and obesity criteriaapplied, weight status; and factors associated with underestimation were also extracted. Given that part of the aim of this systematic review is to examine the diversity of the methods used to evaluate underestimations of children's overweight status, data on the verbatim questionsthat were asked of the participants, verbatim response options, stated justifications for questions and/or responses, whether the participants were aware of weight status before answering, and whether the participants were told of weight status, were also extracted. For the qualitative studies, the data of the participants' estimations, thoughts and views of the children's weight were synthesised, with particular attention on the aspects of overweight andobesity which was meant to produce a narrative understanding of the phenomena of interest.

Table 2.2: Characteristics of the studies included

Author/date Country	Sample characteristics: Age Ethnicity Number of participants Respondents	Sampling, recruitment and settings	Question/s and answers	Stated justification for question and/or responses	Are parents unaware of weight status before answering? Where participants told of weight status?	Cut-off applied	Weight status Percentage of verbal and visual underestimation of overweight status	Factors associated with under-estimation
Abbott *et al.*, 2010 Australia	Age range: 5-17 years Race/ethnicity: Australian, urban and rural Queensland Total number of participants: 6086	A random cluster Healthy -Kids Queensland-Survey 2006 School	Q1 "How would you describe your child's current body weight?" A1"Too thin", "About right", "Too fat"	No direct justification but authors' note survey tools have been replicated to add comparison.	YES NC	IOTF	OWOB 24% Parents verbal 60% Children verbal 36%	Child's gender, Child's BMI

	Respondents: parents of 5 years children and adolescents							
Adams *et al*., 2002 USA	Age range: 4-8years Race/ethnicity: Wisconsin Native American Tribes Total number of participants: 366 Respondents: (74.1%) Mothers, (9.7%) grandmothers, (8.6%)fathers, and (7.6%)other guardians.	Advertisements were posted in newspaper; samples were from schools and other community health fair locations	Q1 Caregivers were asked if child is overweight.	Survey designed by university researchers and community research teams, in order to make the survey "culturally appropriate and non-judgmental"	YES YES	CDC pre-2010	OW 26% Parents verbal 85%	Child's BMI, Grandmother as caregiver.
Akreman *et al*., 2007 USA	Age range: 6-14 years Race/ethnicity: Caucasians, Hispanics, African Americans, and	Convenience sampling from 18 malls.	Q1 Caregivers were asked to provide details of their child's height and weight	This question was used in order to prevent adding the kind of bias associated	YES NC	CDC pre-2010	UW 4% NW 50% AROW 17% OW 25%	NA

	either Asian, Native American multicultural or 'other' -Total number of participants: 1205 -Respondents: 903 mothers, 250 fathers, and 52 reported legal guardians 903 mothers, 250 fathers, and 52 reported legal guardians.			with using visual or verbal scale				
Aljunibi *et al*., 2013 UAE	Age range: 6-19 years Race/ethnicity: United Arab Emirates, Emirati population. Total number of participants: 1440	Convenience sampling from public schools.	Q1 "Do you think that your child's weight is" A1"Underweight", "normal", or "overweight?"	To avoid less desirable and negative weight-based terminology, e.g., fat, or extremely obese (Puhl *et al*., 2010)	NC NC	CDC pre-2010	OW 14.7% OB 18.9% Parents verbal 27%	NA

	Respondents: Mothers							
Al-Mohaimeed *et al*., 2016 KSA	Age range: 6-10 years Race/ethnicity: Saudi Arabian population Total number of participants: 601 Respondents: parents (not specified)	Multi-stage random sampling from Schools	Q1 "Do you think that your child is obese?" Q2 "Is the child's weight normal?"	NR	YES NC	NA	OW and OB in girls 23% in boys 17.5% Parents-verbal 65%	Child's BMI
Al-Qaoudo *et al*., 2010 Kuwait	Age range: 3-6years Race/ethnicity: Kuwaiti population Total number of participants: 2329 Subsample 482 Respondents: mothers	Kuwait Nutrition Surveillance System study, recruited from School	Q1 Parents were asked if a child is overweight. A1 Yes/no	NR	NO NC	WHO	All children were categorised as OW Parents-verbal 97%	NA
Arcan *et al*., 2012	Age range: 4-9 years	Convenience sampling	Q1 "How would you describe your	Previous study that used the	YES NC	CDC post-2010	29% OWOB	Maternal BMI

USA	Race/ethnicity: American Indian Parents living on a reservation in South Dakota Total number of participants: 431 Respondents:, (68%) Mothers (15%) grandmothers, (9%) fathers/stepfathers, and (8%) other.	recruited from schools	kindergarten child's weight?" A1 "very underweight, "slightly underweight", "about the right weight", "slightly overweight", and "very overweight"	same survey was mentioned (Baughcum *et al*., 2000)			Parents-verbal 33%	
Baughcum *et al*., 2000 USA	Age range: 23-60 months Race/ethnicity: (68%) non-Hispanic black, (8%) Hispanic-white, (4%) Asian or Pacific Islander, (3%) Hispanic-black, and	Convenience sampling recruited from paediatric practices and Kentucky WIC program.	Q1 "I feel my child is" A1 "very under-weight", "a little underweight", "about the right weight", "a little overweight", or "very overweight"	Some questions were developed from existing survey by Crist *et al* 1994, Jhonson *et al*., 1994, other questions were	NC NC	CDC pre-2010	OW 16% Parents-verbal 79%	Maternal education

	(16%) other Total number of participants: 622 Respondents: Mothers			developed by from previously collected data in focus groups with dietitians Baughcum *et al*., 1998				
Bossink-Tuna *et al*., 2006 Netherlands	Age range: 2-4years Race/ethnicity: Dutch children living in partly urban but mostly rural area of Netherlands Total number of participants: 682 Respondents: Mothers and fathers	Convenience sampling recruited from health care centre.	Q1 "I am worried my child is overweight right now" Q2 "In comparison with other children his/her age' with regard to weight" A1 "dis-agree a lot, "disagree a little", "no strong feelings either way", "agree a little", and agree a lot".	Previous study that used the same survey was mentioned Campbell *et al*., 2006	NC NC	IOTF	OW 7.2% Parents-verbal 62%	NA

			A2 “much thinner” to “much more overweight”					
Boutelle *et al.*,1998 USA	Age range: 14 years Race/ethnicity: (33%) white, (24%) black, (17%) Asian, (13%)Hispanic, and (13%)other Total number of participants: 755 Respondents: mothers	Convenience sampling from Eating Among Teens (EAT) project.	Q1 How they would describe their adolescent’s current weight? A1 “Very underweight, “Somewhat underweight”, “About right”, “Somewhat overweight”, or “Very overweight”	NR	NC NC	CDC pre - 2010	OW 16.5% AROW 19.9% Parents-verbal 70%	Child’s BMI
Brann *et al.*, 2011 USA	Age range: 8-10 YEARS Race/ethnicity: (Caucasian) Total number of participants: 49 Respondents: Adolescent, mothers and	Flyers, newspaper adverts.	Q1 Adolescent were instructed to choose a picture from the Figure drawings, resembling their present size and the size that they desire to be.	NR	NC NC			

	fathers and their boys		A1 Collins' Figure Drawings (CFD) Q2 Parents were asked to rate their child's 'present' body size, using Collins' Figure Drawings (CFD)					
Brannon *et al.*, 2007 USA	Age range: 3-12years Race/ethnicity: (31%) Hispanic or African American, (21%) white, (8%)other and the remaining (8%) chosen not to identify their ethnicity Total number of participants: 241 Respondents: Parent (not specified)	Convenience sampling recruited from paediatrics clinic.	Q1 5-point liker scale was used when extracting information from parents about their child's size. A1 "too skinny", "thin", "just right", "somewhat overweight", and "overweight".	"Because it's the most common method used on the previous studies therefore it was chosen for this study. Further questions regarding nutritional habit were included to allow parents to answer the	YES NC			

				survey without bias towards weight issues"				
Campbell *et al.*, 2006 Australia	Age range: 4years Race/ethnicity: (Melbourne metropolitan area) Total number of participants: 945 Respondents: Mother, fathers and their children	The PEAS (Parent Education and Support) Program) A community-based cohort study recruited from maternal and child health centres	Q1 "I am worried my child is overweight right now" Q2 "In comparison with other children his/her age' with regard to weight" A1 "dis-agree a lot, "disagree a little", "no strong feelings either way", "agree a little", and agree a lot". A2 "much thinner" to "much more overweight"	Previous study that used the same survey was mentioned (Baughcum *et al.*, 2001)	NC NC	CDC pre-2010	OWOB 11%	NA
Carnell *et al.*, 2005	Age range: 5-3years	Sample recruited from	Q1 "How would you describe your	NR	NC NC	CDC pre-2010	OWOB 30.3%	Child's BMI

England	Race/ethnicity: outer London Total number of participants: 564 parent–child dyads. Respondents: mothers	primary schools, nursery and reception classes	child's weight at the moment?" A1 "very underweight", "underweight", "normal", "overweight" or "very overweight"				Parents-verbal 20%	
Brann *et al*., 2011 USA	Age range: 8-10 years Race/ethnicity: (Caucasian) Total number of participants: 49 Respondents: Adolescent, mothers and fathers and their boys	Flyers, newspaper adverts.	Q1 Adolescent were instructed to choose a picture from the Figure drawings, resembling their present size and the size that they desire to be. A1 Collins' Figure Drawings (CFD) Q2 Parents were asked to rate their child's 'present' body size, using Collins' Figure Drawings (CFD)	NR	NC NC	IOTF	OW 17% OB 3% Parents-verbal 90%	NA

Brannon *et al.*, 2007 USA	Age range: 3-12years Race/ethnicity: (31%) Hispanic or African American (21%) white, (8%) other, and the remaining (8%) chose not to identify their ethnicity Total number of participants: 241 Respondents: Parent (not specified)	Convenience sampling recruited from paediatrics clinic.	Q1 5-point liker scale was used when extracting information from parents about their child's size. A1 "too skinny", "thin", "just right", "somewhat overweight", and "overweight".	NR	NC NC	IOTF	OW 26.9% OB 8% Parents-verbal 81%	Child's BMI
Chaimovitz *et al.*, 2008 Canada	Age range: 5-3years Race/ethnicity: Total number of participants: 182 children and parents Respondents: children aged 12	Convenience sampling from Children's Hospital for following patients coming to the clinic for a gastrointestinal condition.	Q1 Selecting a picture or using words. Physicians also followed the same procedure for categorising the body size of each patient.	NR	NC NC	CDC post 2010	OW 7.7% OB 15.4% Parents-verbal 44% visual 47%	NA

	and older, mothers, fathers, grandmother and physicians		A1 "underweight", "slightly underweight", "average", "slightly overweight", and "overweight"				Children-verbal 44% Visual 43% Healthcare professionals -verbal and visual 33%	
Chaparro *et al.*, 2011 USA	Age range: 30-60 months Race/ethnicity: NC Total number of participants: 1702 Respondents: Mothers	PHFE (Public Health Foundation Enterprises), then the special supplemental nutrition program for women, children (PHFE to WIC) and infants; taken via a computer aided telephone interviewing procedure.	Q1 Mothers were asked "Do you consider your child to be" A1 "overweight", "underweight" or "about right weight for (his) (her) height?"	Previous study that used the same survey was mentioned Campbell *et al.*, 2006	NC NC	CDC post 2010	OW 15.0 % OB 17.0% Parents-verbal 90%	Maternal BMI, child's birth weight.

Chen *et al*., 2014 USA	Age range: 8-15 Years Race/ethnicity NC Total number of participants: 2613 Respondents: mothers	NHANES, a nationally representative and multistage probability sample and noninstitutionalised US population conducted by the National Center for Health Statistics. Interviewed at home.	Q1 Mothers were asked "Do you consider your child to be" A1 "overweight, underweight or about right weight for (his) (her) height?"	NR	NC NC	IOTF	17.4% OW 19.8% OB Parents-verbal 25% Children - verbal 27%	NA
Crawford *et al*., 2005 Australia	Age range 5-6 Years 10-12 years Race/ethnicity: Melbourne Total number of participants: 1210 Respondents: Mothers and fathers	Stratified random sampling from schools	Q1 Centred around 5 choices, parents were instructed to categorise their child's weight during the investigation. A1 'markedly underweight'; 'underweight';	NR	NC NC	IOTF	In children aged 5–6, 23% were OWOB in children aged 10-12, 29% were OWOB Parents-verbal	Child's age

			'average', 'overweight'; 'markedly overweight'.				20%	
de Hoog *et al*., 2012 Netherlands	Age range 5-7 Years 10-12 years Race/ethnicity: Dutch, native African descent, Turkish, Moroccan and 'other' Total number of participants: 2769 Respondents: Mothers and fathers	Follow-up study group known as ABCD (Amsterdam Born Child and their Development). Sample recruited after their gynaecological visit	Q1 "I feel my child's weight is" A1 "much too low, too low, normal, too high or much too high".	NR	NC NC	IOTF	Dutch children OWOB 7.4% Turkish children OWOB 30.6% Moroccan children OWOB 28.0% Parents-verbal 79%	Maternal educational, Immigrant generation
De La *et al*., 2009	Age range 5-12Years 10-12 years Race/ethnicity: USA (90%) non-Hispanic:	Connivance sampling from schools	Q1 Parents were asked to report their child's weight A1 'extremely overweight', 'somewhat	This survey was adapted from previous validated questionnaire, particularly questions	NC NC	CDC Post-2010	OWOB 16% Parents-verbal 75%	Child's gender

	(94%) White and (6%) Other Total number of participants: 576 parent-child pairs Respondents: Parent (not specified)		overweight', 'about right', 'somewhat underweight', or 'extremely underweight'	about demographic factors as well as parental estimation of the child's weight status (Etelson *et al*., 2003).				
Duarte *et al*., 2016 Brazil	Age range 12-36 months Race/ethnicity: NR Total number of participants: 135 parent-child pairs Respondents: (87%) mothers (11%) father and (2%) other relationship	where the connivance sampling from Primary Health Care Facilities	Q1 'Which picture looks most like your child'? Toddler Silhouette Scale (TSS)	NR	NC NC	WHO, 1995	AROW 23.7% OW 9.7% Parents-visual 61%	Child's BMI
Eckstein *et al*., 2006	Age range: 2-7 years Race/ethnicity: (17%) black,	Consecutive sampling from paediatric practices	Q1 'I feel my child is' Q2 "Did your child's doctor	NR	NC NC	CDC pre-2010	AROW 19% OW 20%	Child's age

USA	(35%) Hispanic, (42%) white, (7%) other Total number of participants: 223 Respondents: Mothers		ever tell you that your child is gaining weight too fast or is overweight?" Q3 We also sked the participants to mark the drawing that looked the most like their child. A1 "Underweight", "a little underweight", "about the right weight", "a little overweight", or "overweight" A2 "yes", "no", or "I don't know" A3Collins' Figure Drawings (CFD)				Parents-verbal 64% visual 30%	
Eli *et al*., 2014	Age range: 5-3years	Posts in (job seekers website)	Q1 'What do you think about your child's (or	NR	NC NC	WHO 2000	56% OWOB	NA

USA	Race/ethnicity: majority of children, parents and grandparents were Caucasian living in Eugene and Springfield metropolitan area, Oregon) Total number of participants: 56 Respondents: parents (not specified) and grandparents	and in local newspapers. Parents were interviewed at the Oregon Social Learning Centre.	grandchild's weight'? Q2 In comparison to the child's siblings, cousins and other children.					
Esenay *et al*., 2010	Age range: 5-6years Race/ethnicity: Turkish Total number of participants: 1525 Respondents: Mothers	Connivance sampling from public preschools	Q1 'I am concerned my child is overweight right now' Q2 'compared with peers', with regards to weight A1 a 5-point Likert scale	This survey was developed and created based on the data provided in the earlier studies.	NC NC	Turkish Children's growth curve	OWOB 25.4% Parents-verbal 73%	NA

			(ranging from 'disagree a lot' to 'agree a lot') A2 'much thinner to much more overweight'					
Etelson *et al*., 2003 USA	Age range: 4-8 years Race/ethnicity: NR Total number of participants: 83 Respondents: Parents not specified	convenience sampling from assessing the appointment log	Q1 The method used to find out how parents viewed their child's weight, was to ask themto draw a spot on a line.	NR	NC NC	CDC pre-2010	OW 23% Parents-verbal 59%	NA
Fisher *et al*., 2002 Australia	Age range: 4-8 years Race/ethnicity: Australia (living in rural north western new south wales) Total number of participants: 946	Stratified sampling from public primary schools in the NEAHS in 2002.	Q1 Caregivers were asked to estimate their child's weight. A1 "very underweight", "underweight", "normal weight", "overweight" and "very overweight"	A questionnaire was developed, using a literature review, and adopting standardised instruments (Neuhouser *et*	NC NC	IOTF	OW 13% OB 9% Parents-verbal 56%	Child's gender

	Respondents: Caregivers (not specified)			*al*., 2001) (Block *et al*., 2000)				
Garrett-Wright *et al*., 2011 USA	Age range: 2-5 years Race/ethnicity: Caucasian, Hispanic, African American and others Total number of participants: 120 Respondents: (92%) mothers, (8%) fathers	Researchers approached volunteers for the study in clinics. Researchers used a convenience sampling method	Q1 Mothers were asked to give an account of their child's weight for each phase of their life: Your child during the first year of life, as a toddler, as a pre-schooler, as kindergarten, from3rd through 5th grade, from 6th through 8th grade' A1 'Markedly Underweight Underweight, normal, overweight, markedly Overweight'	Child Feeding Questionnaire used in other study by Birch *et al*., (2001)	NC NC	CDC pre-2010	OW 5.8% Parents-verbal 25%	Health Literacy

Gauthier and Gance-Cleveland, (2015) USA	Age range: 2-5 years Race/ethnicity: Hispanic parent–child dyads Total number of participants: 83 Respondents: mothers	convenience sampling from the Head Start program.	Q1 'I feel my child is' Q2 Mothers were asked to choose the drawing (linear) that looks the most like your child A1 'very underweight, underweight, normal weight, overweight and very overweight' A2 (Eckstein and colleagues, 2006)[22]	NR	NC NC	CDC post 2010	OWOB 50.5% Parents-verbal 50%	Maternal BMI
Genovesi *et al.*, 2005 Italian Milan	Age range: 4-10 years Race/ethnicity: NR Total number of participants: 569 Respondents: Mothers	Healthcare facility.	Q1 'How would you evaluate your body weight'? A1 "very underweight", "underweight", "about the right weight",	The surveywas tested by a statisticianand a psychologist who are particularly skilled in family-based	NC NC	IOTF	OW 23.9 % OB 11.2 % Parents-verbal 28%	Maternal education

			"overweight" and "very overweight"	communications, and was validated by administering it twice in a period of 2 weeks to a pilot group of 14 mothers				
Guevara-Cruz *et al.*, 2012 Mexico	Age range 4-8 years Race/ethnicity: NR Total number of participants: 273 Respondents: Mothers	Convenience sampling from children's hospital.	Q1 'Your children's weight is' Q2' Your children's weight is' A1 'normal not normal' A2 'normal, overweight or obese'.	NR	NC NC	CDC post 2010	OW 74% OB 27% Parents-verbal 38%	NA
Ha *et al.*, 2010 South Korea (Seoul)	Age range: 6-7years Race/ethnicity: NR Total number of participants: 340	Six public schools recruited the Mums of the children, who all had IDs.	Q1 "Do you consider your child to be" A1 "overweight"," just right", or" too	NR	NC NC	Korean CDC 2007	OW 69% Parents-verbal 14%	Child's gender

	Respondents: Mothers		thin (underweight)"?					
Hackie and Bowles, 2007	Age range: 2-5years Race/ethnicity: USA Hispanic families (Southern Nevada culture) Total number of participants: 38 Respondents: Mothers	Convenience sampling from healthcare unit.	Q1 "Do you think your child is overweight?" A1 YES /NO	This survey was used in previous study that asses parental perception of paediatric obesity which is developed by Myers and Vargas (2000).	NC NC	CDC pre-2010	All participants were categorised as OW Parents-verbal 61%	Child's age Maternal education
Hager *et al*., 2012 USA	Age range: 12-13 months Race/ethnicity: American (70.8 %) White (21.7 %) Hispanic (1.8 %) Other (5.7%) Total number of participants: 304 Mothers-toddler Respondents: Mothers	In WIC/urban paediatric clinics	Q1 'Which picture looks most like your child'? A toddler silhouette scale	NR	NC NC	WHO	OW 29.2% AROW 13.9% OB 15.3%. Parents-Visual 70%	Child BMI

Harnack *et al*., 2005 USA	Age range: 2-5 years Race/ethnicity: (86) Non-Hispanic white, (9) Hispanic or Latino, (2) Black/African, (22) American Asian, (8) Other Total number of participants: 1178 Respondents: (90.5%) mother, (9,5%) father	Schools	Q1 "How would you classify your pre-schooler's weight?" A1 "very underweight", "underweight", "average weight", "overweight", and "very overweight".	NR	NC NC	CDC pre-2010	AROW 25.5% OW 12.6% Parents-verbal 91%	NA
He and Evans, 2002 England	Age range: 4-6years Race/ethnicity: (84.8 %) White (15.2%) Non-white Total number of participants: 770 child-parent pair	Convenience sample from elementary schools	Q1 "Compared with other children the same age, do you feel your child is?" A1 "underweight", "slightly	This survey was adapted and modified from previous study by Baughcum *et al*., 2000, particularly	NC NC	CDC post 2010	OW 17.1% OB 13.5% Parents-verbal 63%	NA

	Respondents: Mothers		underweight", "about the right weight", "overweight, or obese".	two questions that asked parents about their views and perceptions of their children's weight status				
Hearst *et al*., 2005	Age range: 12-13 months Race/ethnicity: USA (86.8%) white, (13.2%) others Total number of participants: 375 parent/adolescent dyads Respondents: Parent (not specified)	Sample Aetiology Childhood Obesity study from school	Q1 "Do you consider your child who is enrolled in the study to be" A1 "very underweight", "slightly underweight", "about the right weight", "slightly overweight", or "very overweight"	NR	NC NC	CDC post 2010	OWOB 32.4% Parents-verbal 31%	Child's gender Parental education
Hudson *et al*., 2009 USA	Age range: 3-5 Years	One of the two major urban Head Start centres	Q1 Ask parents to categorise their child's weight, giving them this	Permission was obtained to use and adapt the data	NC NC	CDC post 2010	AROW 18.8% OB 15.6% Parents-	NA

	Race/ethnicity: African American (90%) Total number of participants: 86 parent–child dyads Respondents: 75 (78.1%) mothers, 21 (21.9%) father/ other		selection of answers to select from: A1 'just the right size; Underweight; Overweight'	collection questionnaire used by Nelson *et al*. (2006)			verbal 87%	
Jackson *et al*.,1990 USA	Age range: 35-70 months Race/ethnicity: Georgia (67%) white, 32 (30%) black, and 3 (3%) Asian. Total number of participants: 107 Respondents: Mothers	Convenience sample from pre-schools	Q1 "Do you consider your child to be" A1 'overweight, underweight, or about average in weight'	NR	YES NC	NCHS 1977	OW 15.9% Parents-verbal 94%	Child's BMI Maternal BMI
Jansen and Brug 2006	Age range: 9-11 years Race/ethnicity:	Sample Rotterdam Youth	Q1 'Is your child overweight'?	NR	NC NC	IOTF	OW 21.4 OB 7.4%	NA

	(158) Netherlands (Dutch), (74) Surinam, (56) Moroccan, (113) Turkish, (28) Cape Verdian and (59) others Total number of participants: 1819 parents and their children Respondents: (393) mothers (80) fathers (43) unknown		A1 'not true', 'somewhat true', and 'very true',				Parents-Verbal 80%	
Jones *et al*., 2011 England	Age range: 6-8 years Race/ethnicity: An urban district in northeast England (white British children)	Schools and home visits.	Q1 "How would you describe your child's weight at the moment?" A1 "very underweight", "underweight", "normal",	Q1 (Carnell *et al*l, 2005) was referenced Q2 was adapted and modified for this study to examine	NC NC	IOTF	OWOB 23.7% Parents-verbal 69%	NA

	Total number of participants: 1072 mothers and children Respondents: (528) mother, (6) child's father, (1) step-mothers (1)grandparent		"overweight", "very overweight".	parental perceptions of children's body weight				
Júlíusson *et al.*, 2011 Norway	Age range: 2-19 years Race/ethnicity: NR Total number of participants: 3770 children-mothers Respondents: (3353) answered by the mother, (533) by the father and 231 by both parents and (145) by stepmother, stepfather,	Random sample from Bergen Growth study	Q1 'What do you think about your child's weight status' A1 'Much too thin', 'A little too thin', 'Normal', 'A little too overweight' and 'Much too overweight'.	NR	NC NC	IOTF	OW 10.7% OB 1.9% Parents-verbal 70%	Child' age Child's gender

	grandmother or grandfather).							
Kasemsup and Reick 2006 USA	Age range: 2-5years Race/ethnicity: USA / Hmong Total number of participants: 80 Respondents: mothers	Schools	Q1 Mothers were asked to give an account of their child's weight for each phase of their life: Your child during the first year of life, as a toddler, as a pre-schooler, as kindergarten, from3rd through 5th grade, from 6th through 8th grade A1 'Markedly Underweight Underweight, normal, overweight, markedly Overweight'	NR	NC NC	CDC Pre-2010	AROW/ OW 43% Parents-verbal 77%	NA

Kaufman *et al.*, 2012 Israel	Age range: 4-7 years Race/ethnicity: (48.9%) Europe former (26.6%) Ethiopia and East Africa (24.5%) Other regions of origin. Total number of participants: 462 Respondents: Mothers	Convenience sampling from volunteers in low socio-economic status preschools	Q1 Mothers were asked to report their child as: A1 'thin, normal weight or overweight'	NR	NC NC	WHO	OWOB 29.8% Parents-verbal 82%	Child's BMI
Kersey *et al.*, 2010 USA	Age range: 2-5 Years Race/ethnicity: Mexican American parents (Latino populations) - Total number of participants: 359 Respondents: (90%) mothers and (10%) fathers	convenience sample from community health centre	Q1 Parents were asked to look at the group of line drawings and choose the child that they feel looks the most like theirs	Some questions of this survey was adapted and modified from existing questioner by (Baughcum *et al.*, 2000), and other questions were developed to	NC NC	CDC pre-2010	OW 21% Parents-verbal 65%	NA

				asses parents' knowledge, attitudes, and health beliefs about children's diet, activity, and weight status. during this development prosses, conceptual model for behaviour change was used as a guide (Burnet *et al*., 2008). For the visual scale, it was adapted from earlier study which used the same scale				
				(Stevens *et al*.,1999)				

Kroke *et al.*, 2006 Germany	Age range: 3 month-7 years Race/ethnicity: NR Total number of participants: 235 Respondents: mothers	Participants recruited from the Dortmund Nutritional and Anthropometric Longitudinally Designed study.	Q1 "How do you perceive the body weight of your child?" A1"'just right", "a little too low", "much too low", "a little too high", "much too high".	NR	NO NC	German reference curves (10th UW; 10–90 HW, .90th OW, .97th OB.)	27% OW Parents-verbal 82%	NA
Lazzeri *et al.*, 2006	Age range: 5-15years Race/ethnicity: NR Total number of participants: 3,076 children-mothers- Respondents: mothers	Nutritional Surveillance in Tuscany. School	Q1 'In your opinion your child is …' A1 'very thin, a little thin, normal, a little fat, fat and very fat'. Q2 'Which of these Figures is most similar to your child'?	NR	NC NC	IOTF	OW 21.8% OB 7.9% Parents verbal 35% visual 25%	NA
Lampard *et al.*, 2005	Age range:	Health care facility and school	Q1 Parents were asked to select a Figure that best	NR	NC NC	IOTF	OW 30% OB 12%	NA

	6-13 years Race/ethnicity: NR Total number of participants: 3,076 children-mothers- Respondents: mothers		represented their child's body size Q2 Parents were also asked if they considered their child to be A2 "underweight", "normal weight", "slightly overweight", "moderately overweight", or "markedly overweight"				Parents-verbal 95%	
Laraway *et al.*, 2010	Age range: 6-27 months Race/ethnicity: USA – (7.9%) Hispanic ethnicity (87.2%) White (7.0%) Black (5.1%) Asian (0.7%) Other	Convenience sample from paediatric office	Q1 Parents were asked to choose from the options, how they feel their child's weight was. A1 'much too low, low, just right, high, or much too high'	NR	NC NC	Age- and sex-specific growth curves) underweight <5th; healthy weight 5-85th; overweigh	OW 18% Parents-verbal 70%	NA

	Total number of participants: 279 parent–child pairs Respondents: Parent not specified					t 85-95th; obesity >95th.		
Lopes *et al*., 2012 Portugal	Age range: 9-12years Race/ethnicity: Northern with urban children Total number of participants: 499 urban children Respondents: mothers	A school-based study	Q1 "How would you describe your child's weight at the moment?" A1 "underweight", "normal weight", "overweight or obese"	NR	NC NC	IOTF	OW 25.5% OB 6.4%. Parents-verbal 61%	Maternal educational
Lydecker and Grilo, 2016	Age range: 5-15years Race/ethnicity: USA- (848, 84.2%) White, (66, 6.6%) Black, (60, 6.0%)	The Mechanical Turk online website	Q1 Mothers were asked to give an account of their child's weight for each phase of their life: Your child during the first year of life,	NR	NC NC	IOTF	OW 17% Parents-verbal 45%	Child's gender Child's age Maternal BMI Less fat talk about persons

	Hispanic, (537, 3. %) Asian, (24, 2.4%) multiracial, (21, 2.1%) other Total number of participants: 1007 Respondents: 65.3%) mothers (34.4%) fathers		as a toddler, as a pre-schooler, as kindergarten, from 3rd through 5th grade, from 6th through 8th grade' A1 'Markedly Underweight Underweight, normal, overweight, markedly Overweight'					with obesity and their child
Linchey *et al*., 2019 USA	Age range 8-12 years Race/ethnicity White, Black, Hispanic and Asian Total number of participants: 1002 participants Respondents	A randomized controlled trial from school	Parents were asked to classify their child's weight as "very underweight", "somewhat underweight", "about the right weight", "somewhat overweight", or " very overweight"	NR	NC NC	CDC post 2010	OW 26% OB 30 %.	Parent's weight status and ethnicity not associated

	Mother/Stepmother Father/Stepfather							
Molina de Faria *et al*., 2009	Age range: 7-10 Years Race/ethnicity in Vitória, Espírito Santo State, Brazil. Total number of participants: 1,282 Respondents NC	Conglomerate sampling from schools	Q1 To examine the Mother's view of her child's nutrition, a multiple-choice test was composed. A1 'underweight, normal weight, overweight, obese'	NR	NC NC	IOTF	OW 21% Parents-verbal 61%	Child's gender Child's ethnicity
Mamun *et al*., 2008 Australia	Age range: 5-14 Years Race/ethnicity: Australian adolescents Total number of participants: 2650 mothers-adolescent- Respondents: mothers	The sample was from a Mater-University Study of Pregnancy.	Q1 "Do you think your child is" A1 "very underweight", "slightly underweight" "about the right weight", "slightly overweight" or "very overweight".	NR	NC NC	IOTF	OW 24% Parents-verbal 40%	Child's gender Maternal BMI Child dissatisfaction Dieting

Manios *et al*., 2003 Greece	Age range: 24-60 months Race/ethnicity: (Greek population) Total number of participants: 2278 Respondents: Mother and fathers	Random sampling from nurseries and day care centres	Q1 "I feel my child's weight is" A1 "much higher than normal", "higher than normal", "normal", "lower than normal" or "much lower than normal".	NR	NC NC	CDC pre-2010	24–36 months UW/NW (24%) AROW (23%) OW (20%) 37–48 months UW/NW (45%) AROW (43%) OW (41%) 49–60 months UW/NW (31%) AROW (34%) OW (39%) Parents-Verbal 54%	Child's gender Maternal education Children engaging in physical activity

Mathieu *et al.*, 2010 Canada	Age range: 2-6years Race/ethnicity: (Canadian children) Total number of participants: 1125 Respondents: Mother and fathers	The Quebec Longitudinal Study of Child Development	Q1 'In your opinion, compared with other children the same age and for his/her height, would you say that your child…' A1 'is thin/slim', 'Is of normal weight' or 'Is overweight'.	NR	NC NC	CDC Post-2010	OWOB 77% Parents-verbal 77%	Child's BMI
Maximova *et al.*,2008 Canada	Age range: 2-17years Race/ethnicity: (Canadian children) Total number of participants: 3665 Respondents: Adolescents	The Quebec Child and Adolescent Health and Social Survey from schools	Q1 Children and adolescents chose the Figure (the Stunkard Body Rating Scale), that they felt was the optimum match up to their present appearance.	NR	NC NC	CDC pre-2010	OW 12.7% OB 8.8% Children-visual 22%	Maternal and schoolmate BMI
Moschonis *et al.*, 2011	Age range: 9-13 years	Random, multistage and	Q1 "According to your perception, what is the	NR	NC NC	IOTF	OW 30% OB 11%	Child's gender

Greece	Race/ethnicity: NR Total number of participants: 1858 Respondents: Mother 53% Grandparents 40% Nanny or someone else 6%	stratified sampling from schools	current height of your child?" Q2 Mothers were also asked to select the picture that looked the most similar to their child's body shape A1 "underweight", "normal weight", "overweight" and "obese"				Parents-verbal 15% visual 41%	Primary caregiver other than mothers (Nanny) Maternal BMI and education
Maynard *et al.*, 2003 USA	Age range: kindergarteners to 12th graders Race/ethnicity: (non-Hispanic white, non-Hispanic black, Mexican American), Total number of participants: 5500 children	An in depth stratified, multistage probability cluster sample from the National Health and Nutrition Examination Survey.	Q1 "Do you consider [name of child] to be" A1 'overweight, underweight, or about the right weight'?	NR	NC NC	CDC pre 2010	AROW 12.4% OW 10.3% Parents-verbal 32%	Child's gender Child's age Child's BMI

	Respondents: mothers							
McKee *et al*., 2016 USA	Age range: kindergarteners to 12th graders Race/ethnicity: - 54.4% were White (7,808), and 45.6% were Black (6,552), Total number of participants: 14808 Respondents: Parents not specified	Random sample from public school	Q1 'What would you say best describes [your child's] weight'? A1 'underweight, healthy weight, overweight, or obese'	NR	NC NC	CDC pre-2010	OW 38.4% Parents-verbal 82%	Child's BMI
Miller *et al*., 2007 New Zealand	Age range: 3-8 years Race/ethnicity: (9 were white, 10 were New Zealand Maori, and 2were of Pacific Island ethnicity)	A sample was taken from the nutritional investigation on bone and dental health.	Q1 Parents were asked to categorise their child's weight. A1 "score 1 Underweight;" "score 2 normal-weight"; "score 3 slightly overweight";	NR	NC NC	CDC pre-2010	AROW 31% OW 9% Parents-verbal 86%	NA

	Total number of participants: 101 Respondents: Parents not specified		"score 4 overweight"					
Moore *et al*., 2006	Age range: 2-17 years Race/ethnicity: Atlanta, Georgia (African American) Total number of participants: 77 Respondents: Mothers	Connivance sample was from waiting room of health care facility	Q1 "I feel my child is" Q2 "Has your child ever been told by a doctor that he/she is at-risk for overweight, overweight, or obese?" A1 "underweight", "normal weight", "a little overweight", or "overweight'" A2 Yes/no	NR	NC NC	CDC post 2010	AROW 19.5% OW 22.1% Parents-verbal 19%	Absent of physician comment on weight
Musaad *et al*., 2015 USA	Age range: 22–63 months- Race/ethnicity: (34) Hispanic,	Unequal probability sampling from	Q1 Mothers were asked to give a description of their child's	NR	NC NC	CDC post 2010	OW 18. % Parents-	NA

	(131) Non-Hispanic Black, (278) Non-Hispanic White, (54) Other Total number of participants: 497 Respondents: Mothers	health care facilities	weight, for each phase of their life: 'Your child as a pre-schooler'. A1 'Markedly Underweight Underweight, Normal Overweight Markedly Overweight'.				verbal 90%	
Myers and Vargas, 2011	Age range: 2-5Years Race/ethnicity: USA -Hispanic ethnicity Total number of participants: 200 Respondents: Parents (not specified)	Convenience sampling from WIC health centre or child health services	Q1 "Do you think your child is overweight"? A1 Yes, No	Questionnaire was developed by researcher	NC NC	CDC post 2010	All participants were categorised as OB Parents-verbal 45%	NA
Perrin *et al*., 2010 USA	Age range: 4-12 Years Race/ethnicity: USA 90% of study	Health care facility	Q1 Parents were asked to describe their child's weight using	NR	NC NC	WHO	All children were categorised as OW	NA

	participants were non-Hispanic, and 65% were black/African American. Total number of participants: 115. Respondents: Parents (not specified)		standard terminology A1 "underweight", "healthy weight", "at risk for overweight", and "overweight"				Parents-verbal 91%	
Petricevic *et al.*, 2012 Croatia	Age range: 6-7 years Race/ethnicity: NR Total number of participants: 1068. Respondents: (83.0 %) Mothers (10.9 %) fathers or (6.2 %) both parents	From three health services	Q1 "Do you consider your child to be" A1 'underweight', 'of normal weight', or 'overweight'?	NR	NC NC	NA	OW 12.6 % OB 10.2 % Parents verbal 0.3%	Child's BMI

Ra *et al*., 2016	Age range: 3-6 years Race/ethnicity: NR Total number of participants: (388) children, (388) their mothers, and (23)their preschool teachers. Respondents: Children, mothers and teachers	By putting adverts on the Korean Association of Public Kindergarten Teacher's website	Q1 Each child was asked to choose the photo that best resembled their present look ('Which picture looks most like you'?) Q2 Mother and teacher were asked to select: (a) the body shape that looks the most like their child (b) the body shape that is perfect in their eyes Collins' Figure Drawings (CFD) [35]	NR	NC NC	IOTF	OW 7.2% OB 1.6% Parents-verbal 42% Children Verbal 39%	Child's and maternal BMI Weight satisfaction Teachers' education level Perception of and satisfaction with child's body weight, Attitude toward obesity Body image
Redsell *et al*., 2010 England	Age range: 1-11 months Race/ethnicity: 29 (76.3%) White British,	The UK National Child Measurement Programme recruited from	Q1 "Can you describe your baby's size at birth and your	NR	NC NC	CDC pre-2010	NA	NA

	4 (10.5%) White European, 3 (7.9%) Black – other, 1 (2.6%) White – other, 1 (2.6%) Asian – other. Total number of participants: 38 Respondents: 36 Mothers 2 Fathers	attending child health clinics	thoughts about this?"					
Reifsnider *et al.*,2006	Age range: 2-9 years Race/ethnicity: NR Total number of participants: 16 220 Children Respondents: Mothers	Convenience sampling from two Head Start Centres	Q1 Mothers were asked about their view about their child's weight A1 "much too underweight'" "slightly too underweight", "proper weight", "slightly too overweight"	NR	NC NC	CDC Pre-2010	OWOB 19% Parents-verbal 19%	NA
			and "much too overweight"					

Robinson and Sutin, 2017 Study 1 Australia (Australian famillies) Study 2 Republic of Ireland, Europe	Age range; Study 1 (4-5 years to 14-15 years) Study 2(9-13 years) Race/ethnicity: NR Total number of participants: Study 1 N=2823 Study 2 N=5886 Respondents: Study 1 mothers and children Study 2 mothers and children	Two longitudinal cohort studies	Study 1 / Q1 "Which of these best describes your child?" Q2 "Which picture looks most like your body shape?" Study 2/ Q1 For mothers 'Which do you think your child is'? Q2 For children / 'How would you describe yourself'? Study 1 A1 "underweight", "normal weight", "somewhat	NR	NC NC	CDC pre-2010	OW 61.9% OWOB 30.6% parents-verbal 55%	NA

			overweight", and "very overweight" Study 2 A1 "very underweight", "moderately underweight", "slightly underweight", "about the right weight", "somewhat overweight", "moderately overweight", and "very overweight". A2 "very skinny", "a bit skinny", "just the right size", "a bit overweight", and "very overweight".					
Regber *et al*., 2003	Age range: 2-9 years	The Identification and prevention	Q1 Use the five-point Likert system to assess	NR	NC NC	IOTF	OWOB 18% Parents	child's BMI

Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain and Sweden.	Race/ethnicity: NR Total number of participants: 16220 Respondents: parents	of dietary and lifestyle induced health effects in children and infants (IDEFICS) study from Kindergartens or school	the parents view of their child's weight. "much too underweight'" "slightly too underweight", "proper weight", "slightly too overweight" and "much too overweight"				verbal 63%	
Rosas *et al*., 2010 Mexico and California	Age range: 5 years Race/ethnicity: NR Total number of participants: 285 Respondents: 4 fathers, 45 mothers	A longitudinal birth cohort study of pregnant women and their children.	Q1 Mothers were asked to choose the Figure that they see as matching their child's present appearance the most accurately. A1 Collins' Figure Drawings (CFD)	This study used visual scale not verbal scale in order to avoid using weight labels	NC NC	IOTF	AROW California 15.0% Mexico 8.3% OW California 41.7% Mexico 6.7% Parents-visual 90%	NA

Rudolph *et al*., 2007 Germany	Age range: 7-17 years Race/ethnicity: NR Total number of participants: 285 Respondents: 4 fathers, 45 mothers	Convenience sampling from paediatric pulmonary disease out-patient clinic	Q1 Children and parents were asked A1 "very underweight", "underweight", "normal", "overweight", "very overweight".	NR	NC NC	WHO	OW 3.5% OB 17% Parental-verbal 2.0%	NA
Rodrigues *et al*.,2020 Portugal	Age range: 7-10 years Total number of participants 793 Respondents 619 Mothers, 174 fathers	Cross sectional study design from extracurricular sport and obesity rates in Portuguese elementary school children Cross sectional study design from extracurricular sport and obesity rates in Portuguese	"How would you describe your child's weight at the moment? Possible answers were one of the following four choices: "My child's weight is a bit too little," "My child's weight is OK," "My child's weight is a bit too much," and "My child's weight is way too much."	NR	NC NC	IOTF	OW 16% OB 6% Parents-verbal 31%	Child's age, gender Maternal weight status

		elementary school children						
Ruiter *et al*., 2020 Netherlands	Age range: 2-12 years Race/ethnicity: NA Total number of participants 2009 (n = 8105), 2013 (n = 8844) and 2017 (n = 11,022) Respondents NA	Complex sampling design from a community-based survey	Q1 "What do you think of your child's weight?". A1 ''extremely low", "low", "normal", "heavy", and "extremely heavy"	NR	NC NC	IOTF	OW 17% OB 4% Parents-verbal 95%	Child's age , gender, parental higher education
Shrewsbury *et al*. 2012 Australia	Age range: 13-year-olds in 2002-2003 (n=347) followed up at age 15 years (n=279) and their mothers. Race/ethnicity: (Australian families)	Longitudinal Nepean Study from Nepean Hospital	Q1 "How would you classify your child's weight now?" A1 "markedly underweight", "underweight", "average", "over-weight", or "markedly overweight"	NR	NC NC	IOTF	13 years OW (27%) 15 years OW (90%) Parents-verbal 54%	Child's BMI Child' gender

	Total number of participants: 626 Respondents: mothers							
Skelton *et al*., 2006 USA	Age range: Children aged 10-19 years parents of children aged 4–20 years Race/ethnicity: African American Total number of participants: 44 Respondents: Parents (not specified) and their children	Convenience sampling from the inner-city health fair	Children were asked Q1 "Do you think you are" Q2 "Do you think your weight is" A1 "underweight (too skinny)", "normal weight", "overweight (weigh too much)" A2 'healthy', 'unhealthy', 'other'	NR	NC NC	CDC pre-2010	37% AROW (19%) OW (18%). Parents verbal 80% Children verbal 70%	NA
Spurrier *et al*., 2006 South Australia	Age range: NA Race/ethnicity: NA Total number of participants: 44	Health care facility	Q1 Ask participants, whether the child was: A1 'underweight, acceptable weight, overweight or	NR	NC NC	CDC/NCHS 2000	NA GPs 72% and paediatricians 68%.	NA

	Respondents: General practitioners and paediatricians		obese', based on a series of body images					
Tarasenko *et al.*,2014 USA	Age range: 8-15 years Race/ethnicity: (58.6%) non-Hispanic white, (14.2%) non-Hispanic black, and (19.0%) Hispanic Total number of participants: 4691 Respondents: Children, their guardians, and healthcare professionals	Multi-stage probability sample from the 2005–2010 NHANES	Q1 caregivers were asked if they view their child as: Q2 Guardians were asked if "a doctor or health care professional ever told" them that their child is categorised as overweight. Healthcare professionals s' estimations were based on the parents' report of being informed by healthcare professionals that the child was	NR	NC NC	CDC post 2010	OW 16.4% OB 19.3% Parents verbal 70% Children verbal 42% Healthcare professionals verbal 41%	NA

			categorised as overweight Q3 Ask children and adolescents, if they view themselves as: A1 “overweight”, “underweight”, or “about the right weight”. A3 “fat” or “overweight”, “too thin”, or “about the right weight”.					
Thompson *et al*., 2014 USA	Age range: (3–6, 7–10, 11–14 and 15–20 months Race/ethnicity: Low-income African American mothers Total number of participants: 237	WIC clinics or a longitudinal cohort of the Infant Care and Risk of Obesity Study.	Q1 Open-ended questions explored mothers’ perceptions of healthy infant Q2 whether their infants can be categorised as under/overweight	The questions of the interview were based on earlier work by Bentley *et al*. (1999) in a similar population	NC NC	CDC pre-2010	OW 3 months 29.5% 6 months 27.1% 9 months 24.4% 12 months 23.8% 18 months 19.4%	NA

	Respondents: mothers		Q2 “my infant is fat right now” and ‘my infant is thin right now” A2 strongly disagree to strongly agree scale					
Tschamler *et al.*,2010 USA	Age range: 18 m -9 years Race/ethnicity: (20%) Hispanic (10%) Non-Hispanic, (10%) wheit, (40%) Black and (20%) others -Total number of participants: 139 Respondents: mothers (89%), other(11%)	Convenience sampling from healthcare facility	Q1 ‘Would you classify your child as’ A1 “very underweight”, “a little underweight”, “about right”, “a little overweight”, or “very overweight”	NR	NC NC	CDC Post-2010	NW 69% OW31% Parents Verbal 46%	NA
Twarog *et al.*, 2016	Age range: 6-15 years	NHANES 2005–2008 and 2009–	Q1 “Do you consider (SP) now to be?”	NR	NC NC	IOTF	All children were	Child’s gender Child’s

USA	Race/ethnicity: n= 206 (63.0%) White, n=264 (67.0%) Black , n= 436 (69.4%) Hispanic, n=54 (63.0 %) others. Total number of participants: 1449 Respondents: parents not specified	2012. In homes interview	Q2 "How do you consider SP's weight?" A1/A2 "overweight", "underweight", or "just about the right weight"				categorised as OWOB Parents verbal 70%	ethnicity
Vanhala *et al*., 2004 Finland	Age range: 10 years Race/ethnicity: NR Total number of participants: 749 Respondents: mothers	Health care clinics.	Q1 My child is A1 underweight', 'normal weight', 'slightly overweight' and 'heavily overweight'.	NR	NC NC	IOTF	At 5 years OW13.3% OB 22.2% At 11 years OW 20% OB 23% Parents-verbal 57%	Child's gender Child's BMI
Vuorela *et al*., 2010	Age range:	Convenience sampling from	Q1 "Do you consider your	NR	NC NC	IOTF	At 5 years OW 13.3%	NA

Finland	5-11 years Race/ethnicity: NR Total number of participants: 606 Respondents: mothers	healthcare facility	child underweight, normal weight, overweight or obese?"				OB 22.2% At 11 years OW 20% OB 23% Parents verbal 51% Children Verbal 39%	
Vrijkotte *et al.*, 2020 Netherlands	Age range: 5-12 years Total number of participants 4488 participants Race/ethnicity: Dutch, Surinamese, Turkish, Moroccan or Other Mothers	Follow-up study group known as Amsterdam Born Children and their Development (ABCD)	Mothers were asked what they thought of their child's weight status A1"way too heavy"; "too heavy", "just right", "too light", "way too light"	NR	NC NC	IOTF	OW 9% at baseline and 10.8% at follow-up Parents verbal 80%	Ethnicity Education
Wald *et al.*, 2004	Age range: 3-12 years Race/ethnicity:	Convenience sample design from	Q1. "Do you think your child is overweight?"	NR	NC NC	CDC pre-2010	AROW 15%; OW 44%	Child's gender

USA	(Approximately one-third African-American, two-thirds Caucasian) Total number of participants: 612 Respondents: Mothers	healthcare facility	A1 Yes/no				Parents verbal 58%	
Webber *et al*., 2010 England	Age range: 7-9years Race/ethnicity: White (62.4%), non-white (37.65) , Black and mixed black (14.6%) Asian/mixed Asian (17.85) Other (5.2%) Total number of participants: 405 Respondents: Mothers	Schools	Q1 "How would you describe your child's weight at the moment" A1"very underweight, underweight, normal, overweight and very overweight"	Has been used with parentsof children of a similar age (Carnell *et al*., 2005).	NC NC	IOTF	OW 12.2% OB 3.8% Parents verbal 55%	NA
Wen and Hui, 2009	Age range: 10-15years	Stratified random	Q1 Parents were asked to describe	Method used in a previous	NC NC	WHO	OW 16.7 %	Adolescent s' gender

China	Race/ethnicity: (urban areas) Total number of participants: 2162 Respondents: Adolescents and parent (not specified)	sampling from schools	their children's weights subjectively A1 "very underweight, slightly underweight, normal, slightly overweight and very overweight" Q2 For adolescents "Which picture looks the most like how you look"? A2 Collins' Figure Drawings (CFD)	study (Warschburger and Kroller 2009)			Parents verbal 40% Children visual 30%	
West *et al*., 2008 USA	Age range: Pre-adolescent aged 3–12 years and Adolescents, aged 13–19 years Race/ethnicity: African American	A multi-stage stratified sampling from schools	Q1 Parents were asked if they considered their child weight to be. A1 'overweight, at-risk-of-overweight, a	This method of establishing parental perception of child weight status is similar to the approach	NC YES	WHO,1995	AROW 17% OW 21% Parents verbal 60%	Child's Ethnicity

	Total number of participants: Baseline 2003–2004 (n = 1,551) 1-year follow-up 2004–2005 (n = 2,508) Respondents: parents not specified		healthy or normal weight, or underweight'	utilized in other studies (Baughcum *et al*., 2000)				
Wong *et al*., 2013 Taiwan	Age range: 4-6 year Race/ethnicity: NR Total number of participants: 699 Respondents: children, mothers, fathers, grandparents, aunts and teacher	A purposive sampling, from public and private kindergartens	For children Q1 "Which picture looks the most like you?" For mothers Q2 "which picture looks the most like your child?" A1/2 Collins' Figure Drawings (CFD)	NR	NC NC	NHANES (1990)	OW 14.3 % OB 8.3% Parents visual 57%	NA
Yao and Hillemeir, 2006	Age range: 6–12 and 13–18 years.	An ongoing, population-based longitudinal	For mothers Q1 "Do you think your child is?"	NR	NC NC	CDC post 2010	OW 27.5% Parents verbal	Child's BMI Maternal weight

China	Race/ethnicity: NR Total number of participants: 1265 Respondents: Mothers and children	survey in a clinical setting	For children Q2 "Do you think you are now?" A1/2 "Underweight", "normal" or "overweight?"				72% Children verbal 69%	
Young-Hyman *et al*., 2000 USA	Age range: 5-11 years Race/ethnicity: African American families. Total number of participants: 111 Respondents: (62%) mothers (5%) fathers (12%) mothers and fathers (14%) grandmothers and (7%) others.	A purposive sampling from health care facility.	Q1 'Which best describes your child's weight?' A1 'underweight, just right, overweight, very overweight'	NR	YES NC	NHANES (1990)	OWOB 91% Parents verbal 21%	NA

*IOTF (International Obesity Taskforce) OWOB (Overweight and Obesity) OB (Obesity)NR (Not Reported) NC (Not Clear)

Child Weight Status Categorization

Objective measures

Across the studies, all were based on weight to height ratios with different criteria for categorization to determine a child's weight status. The International Obesity Task Force's (IOTF) sex-specific and age-specific cut-offs were used in (n=30) studies, whilst (n=24) studies classified children as at risk of overweight when their BMI is between 85th–95th and overweight when their BMI is ≥ to the 95th percentile (Centres for Disease Control and Prevention-Pre 2010). The World Health Organisation (WHO) growth standards were used in nine of the studies. Spurrier *et al*., (2006) used the 90th percentile as the cut-off point for overweight, consistent with the CDC growth chart. The CDC post-2010 was employed in several studies, which considers overweight to be a BMI between the 85th and 95th percentiles, while obesity is considered a BMI of greater than or equal to the 95th percentile (n = 16). Kroke *et al*., (2006) utilized German reference curves, classifying children as obese, where BMI was greater than or equal to the 90th percentile, while obesity was linked to the 97th percentile. Esenay *et al*., (2010) utilised the Turkish growth curves, which classify overweight based on the 85th and 95th percentiles and obesity as greater than or equal to the 95th percentile. Finally, Young-Hyman *et al*., (2000) employed the National Centre Health Statistics, 1990 as the cut- off point, which considers adolescents in the 95th to 99th percentiles to be classified as overweight, while those greater than the 99th percentile are classified as obese.

Subjective Measures

Across 80 of the studies, the participants verbally classified their children's or their own weight status with a forced-choice rating scale, whereby participants described their weight status by selecting a category that was based on medicalised weight related standards. In 20 cases, a numerical Likert-type scale was employed, in which a child's weight was considered along a

spectrum, from very underweight to very overweight. Across the included studies, differing terms were used to describe overweight and obesity (e.g. 'underweight' to 'obese,' 'underweight' to 'overweight,' 'somewhat thin' to 'somewhat heavy,' 'markedly underweight' to 'markedly overweight' and 'thin' to 'fat'). One study relied on a visual analogue scale, where caregivers were requested to mark the spot on the line correlated with their child's weight status (Etelson *et al*., 2003).

In 13 studies, visual evaluations of sketches, silhouettes, photographs, and Figures where used. In a group of silhouettes, participants were asked to select the Figure that described their own child's or their own weight status. The majority (n=6) used the validated pictorial instrument by Collin *et al*., (1991). Hager *et al*., (2012) and Duarte *et al*., (2016) used the validated Toddler Silhouette Scale by Hager *et al.,* (2010) asking parents/carers, "Which picture looks most like your child?". Chaimovitz *et al*., (2008) compared parents', children's and physicians' perceptions of children's weight using a body image scale to indicate the Figure that most correctly describe the child's weight. Children alone were asked to select which silhouette looks most like their body shape in (Maximova *et al*., 2008; Robinson *et al*., 2017).

Eckstein *et al*., (2006) examined a tool that involves gender-specific and age-range-specific outlines of children to evaluate parental views of their child's body weight. It was found that when compared to written questions, images facilitated greater accuracy in the categorisation of a child's weight based on their height. Furthermore, Lazzeri *et al*., (2006) reported that mothers tended to have more precise views of their children's nutritional status when selecting silhouettes corresponding to BMI, rather than when using multiple-choice questions. Although Moschonis *et al*., (2010) reported that mothers' assessments of their children's weight status were more accurate when using verbal rather than visual classification tools, the study relied on outdated NCHS growth charts from 1979 which depicted only pre-pubescent children.

Chaimovitz *et al*., (2008) also employed verbal and visual scales for the assessment of perceived weight status, the intention being to safeguard against the influence of weight-related terminologies used in the measure. The rate of weight status underestimation was comparable across the two scales, which is consistent with this study's meta-analysis which provides very similar estimates of the extent of underestimation by parents/carers, regardless of the use of verbal or visual scales. The same process of underestimation of overweight and obesity is also found when healthcare professionals were asked whether each child was classified as underweight, having a healthy weight, overweight or obese. Although there was insufficient data to perform a meta-analysis, (Spurrier *et al*., 2006; Chaimovitz *et al*., 2008; Tarasenko *et al*., 2014) all reported underestimation of overweight by a significant number of healthcare professionals. These studies included general practitioners (GPs) and paediatricians as well as physicians from hospitals, medical centres and clinics. Among the reasons proposed to explain why healthcare professionals may underestimate children's overweight status is that healthcare professionals do not take weight measurements or provide weight management guidance because their patients do not seem to be overweight or obese (Robinson, 2017).

Phenomenological methods were employed by three studies (Redsell *et al*., 2010; Eli *et al*., 2014; Thompson *et al*., 2014) in order to gain insight into parents' perceptions of their children's weight status. These studies adopted qualitative research designs with semi-structured interviews and focus groups. The results from the studies indicated that mothers conceptualised a child's weight differently and no participant held to the medical definition of childhood obesity which the researchers proposed. Instead, a preschool child was considered to have a healthy weight if they could take part in a specific activity, appeared healthy, were happy, and were not bullied (Redsell *et al*., 2010; Eli *et al*., 2014; Thompson *et al*., 2014) reported that no participant described the weight status of pre-school children as 'obese' or

'overweight' but used terms such as 'chunky', 'stout', 'chubby', 'stocky', 'big boned', 'robust', 'solid', and 'pudgy'.

Methodological Quality

Objective outcome measures were employed in almost every study (n=90) except one where weight and height were reported by parents Lydecker *et al*., (2016). In (n=63) studies, it was not clear whether the experimental equipment was standardized, and information was rarely given as to whether the objective child weight assessment process involved identical equipment across the entire sample. In the majority of studies (n=80), data were not gathered as to whether participants already knew about the child's weight status. Weight classification methods, confounding variables, statistical analysis methods and the possibility of non-respondent bias were identified in almost all studies as issues that could have reduced the methodological quality of the studies. With reference to the diversity of the methods used to assess underestimation of overweight status, it was observed that 75% of the included studies offer no explanation or justification for using specific terminology in question and/or responses in the verbal assessment method. The methodological quality ranged from high to low quality however the majority were relatively high in most of the studies (see Table 2.3). Therefore, the results seem to give a reliable estimate of the available data on this subject.

Table 2.3 Results for quality assessments.

Authors	Methods used to select participants (sampling bias)	Adequate sample size for the outcome of interest (performance bias)	Methods used for controlling confounding variables (performance bias)	Appropriate statistical methods (detection bias)	Handling missing data (detection bias)	Methods of the outcome measure (information bias)	objective assessment method of the outcomes (information bias)
Abbott *et al*., 2010	3 LR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
Adams *et al*., 2005	0 HR	3 LR	2 MR	3 LR	3 LR	2 MR	3 LR
Akerman *et al*., 2007	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR	3 LR
Aljunaibi *et al*,. 2013	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR	3 LR
Al-Mohaimeed, 2016	3 LR	3 LR	2 MR	3 LR	3 LR	3 LR	3 LR
Al-Qaoud *et al*., 2010	2 MR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Arcan *et al*., 2012	3 LR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Baughcum *et al*., 2000	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Bossink-Tuna *et al*.2006	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR

Boutelle *et al*. 1998	3 LR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
Brann *et al*., 2011	2MR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Brannon *et al*., 2007	3 LR	3 LR	2 MR	3 LR	3 LR	2 MR	3 LR
Campbell *et al*., 2006	2 MR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Carnell *et al*., 2005	2 MR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
Chaparro *et al*., 2011	2 MR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Chen *et al*., 2014	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Chaimovitz *et al*., 2008	3 LR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Crawford *et al*., 2005	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
de Hoog *et al*., 2012	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
De La *et al*., 2009	2 MR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Duarte *et al*., 2016	2 MR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Eckstein *et al*., 2006	3 LR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Eli *et al*., 2014	3 LR	3 LR	3 LR	3 LR	0 HR	3 LR	3 LR
Esenay *et al*., 2010	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR

Etelson *et al*., 2003	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Fisher *et al*., 2002	2 MR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Garrett-Wright *et al*., 2011	2 MR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Gauthier and Gance, 2015	2 MR	1 HR	3 LR	3 LR	3 LR	2 MR	3 LR
Genovesi *et al*., 2005	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Guevara-Cruz *et al*., 2012	3 LR	3 LR	3 LR	3 LR	0 HR	3 LR	3 LR
Ha *et al*., 2010	2 MR	3 LR	3 LR	3 LR	0 HR	3 LR	3 LR
Hackie and Bowles, 2007	2 MR	0 HR	3 LR	3 LR	3 LR	2 MR	3 LR
Hager *et al*.2012	2 MR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Harnack *et al*., 2005	2 MR	3 LR	3 LR	3 LR	2 MR	3 LR	3 LR
He and Evans, *et al*., 2002	2 MR	0 HR	2 MR	3 LR	3 LR	3 LR	3 LR
Hearst *et al*., (2005-7)	2 MR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Hudson*e t al*., 2009	2 MR	3 LR	2 MR	3 LR	3 LR	3 LR	3 LR

Jackson *et al*., 1990	3 LR	3 LR	2 MR	3 LR	3 LR	3 LR	3 LR
Jansen and Brug, 2006	3 LR	3 LR	3 LR	3 LR	0 HR	3 LR	3 LR
Jonse *et al*., 2011	2 MR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
Júlíusson *et al*., 2011	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Kasemsup and Reick, 2006	2 MR	0 HR	3LR	3 LR	0 HR	3 LR	0 HR
Kaufman-Shriqui *et al*., 2012	2 MR	0 HR	2 MR	3 LR	3 LR	3 LR	3 LR
Kersey *et al*., 2010	0 HR	3 LR	2 MR	3 LR	3 LR	3 LR	3 LR
Kroke, Strathmann and Günther, 2006	2 MR	0 HR	2 MR	3 LR	3 LR	2 MR	3 LR
Lampard *et al*., 2005	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Laraway *et al*., 2010	2 LR	3 LR	3 LR	3 LR	0 HR	2 MR	3 LR
Lazzeri *et al*., 2006	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Lopes *et al*., 2012	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Lydecker and Grilo, 2016	2 MR	3 LR	0 HR	3 LR	3 LR	0 HR	0 HR

Linchey *et al.*, 2019	0 HR	0 LR	3 LR	3 LR	3 LR	3 MR	3 LR
Molina de Faria *et al.*, 2009	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Mamun *et al.*, (2008)	2 MR	3 LR	0 HR	3 LR	2 MR	3 LR	3 LR
Manios *et al.*, (2003)	3 LR	3 LR	2 MR	3 LR	3 LR	3 LR	3 LR
Mathieu *et al.*, 2010	2 MR	3 LR	2 MR	3 LR	3 LR	3 LR	3 LR
Maximova *et al.*, 2008	3 LR	3 LR	2 MR	3 LR	2 MR	3 LR	3 LR
Maynard *et al.*, 2003	3 LR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
McKee *et al.*, 2016	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Miller *et al.*, 2007	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Moore *et al.*, 2006	3 LR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Moschonis *et al.*, 2011	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Musaad *et al.*, 2015	3 LR	3 LR	0 HR	3 LR	3 LR	3 LR	3 LR
Myers and Vargas ,2001	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR

Perrin *et al*., 2010	2 MR	0 HR	3 LR	3 LR	3 LR	2 MR	3 LR
Petricevic *et al*., 2012	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Ra *et al*., 2016	2 MR	3 LR	2 MR	3 LR	0 HR	3 LR	3 LR
Redsell *et al*., 2010	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Rosas *et al*., 2010	2 MR	0 HR	2 MR	3 LR	3 LR	3 LR	3 LR
Regber *et al*., 2003	2 MR	3 LR	2 MR	3 LR	3 LR	2 MR	3 LR
Reifsnider *et al*., 2006	2 MR	0 HR	3 LR	3 LR	3 LR	2 MR	3 LR
Robinson and Sutin., 2017	3 LR	3 LR	2 MR	3 LR	3 LR	3 LR	3 LR
Rudolph *et al*., 2007	3 LR	3 LR	3 LR	3 LR	3 LR	2 MR	3LR
Ruiter *et al*., 2020	0 LR	3 LR	3 LR	3 LR	0 HR	3 LR	0 HR
Rodrigues *et al*., 2020	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Shrewsbury *et al*., 2012	3 LR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
Skelton *et al*., (2006)	0 HR	0 HR	3 LR	3 LR	3 LR	2 MR	3 LR
Spurrier, *et al*., 2006	0 HR	0 HR	3 LR	3 LR	3 LR	2 MR	0 HR

Tarasenk *et al*., 2014	3 LR	3LR	3 LR	3 LR	3 LR	2 MR	3 LR
Thompso n *et al*., 2014	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Tschamle r *et al*., 2010	2 MR	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR
Twarog *et al*., 2016	3 LR	3 LR	2 MR	3 LR	3 LR	3 LR	3 LR
Vanhala *et al*., 2004	0 LR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Vuorela *et al*., 2010	3 LR	3 LR	2 MR	3 LR	2 MR	3 LR	3 LR
Vrijkotte *et al*., 2020	0 HR	3 LR	3 LR	0 HR	3 LR	3 LR	3 LR
Wald *et al*., 2004	0 HR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
Webber *et al*., 2010	3 LR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
Wen and Hui, 2009	3 LR	3 LR	3 LR	3 LR	3 LR	2 MR	3 LR
West *et al*., 2008	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR	0 HR
Wong *et al*.2013	2 MR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR
Yao and Hillemeir, 2006	2 MR	0 HR	2 MR	3 LR	0 HR	3 LR	3 LR
Young-hyman *et al*., 2000	0 HR	3 LR	3 LR	3 LR	3 LR	3 LR	3 LR

*0 HR (HIGH RISK), 1 and 2 MR (MODERATE RISK), 3LR (LOW RISK)

Meta-Analyses of Underestimation

Sensitivity analysis

In forest plot, few studies can have effects size that look speared from the data, and hence it is important to determine if these outlying effect sizes may influence the overall effect size. It has been suggested by Viechtbauer &Cheung (2010) that using a set of leave-one-out is important to identify the influential studies, such as difference in its values (DFFITS), Cook's distances, and also estimates for τ^2 and the Q-statistic for heterogeneity. For the current analysis, figures 2.2 and 2.3 show the studentized deleted residuals, DFFITS values, Cook's distances, and Cov-ratio values. As seen in the Cov-ratio, values are based a log scale, thus that deviations which are less than and higher than 1 can be compared. From the plot of the studies examined parental perceptions evaluated via verbal assessment scale, it can be noticed that study 57 and 17 are potential outliers, however looking at Cov-ratio, the value of 0.96 is much closer to one, and therefore the study remained for meta-analysis. On the other hand, from the plot of the studies examined parental perceptions assessed via visual assessment scale, it can be seen that, study 5 showed different pattern. Yet, no change in the estimate was seen if these studies were removed. Similarly, for the studies assessed children and adolescents' underestimation of their own weight status, after analysing the studentized deleted residuals, DFFITS values, Cook's distances, and Cov-ratio values, no clear outliers can be observed, and changes in the estimate were seen if any of these studies were removed 2.4

Figure 2.2: Plot for examining outliers from the parental underestimate proportion of children with overweight and obesity via verbal scale.

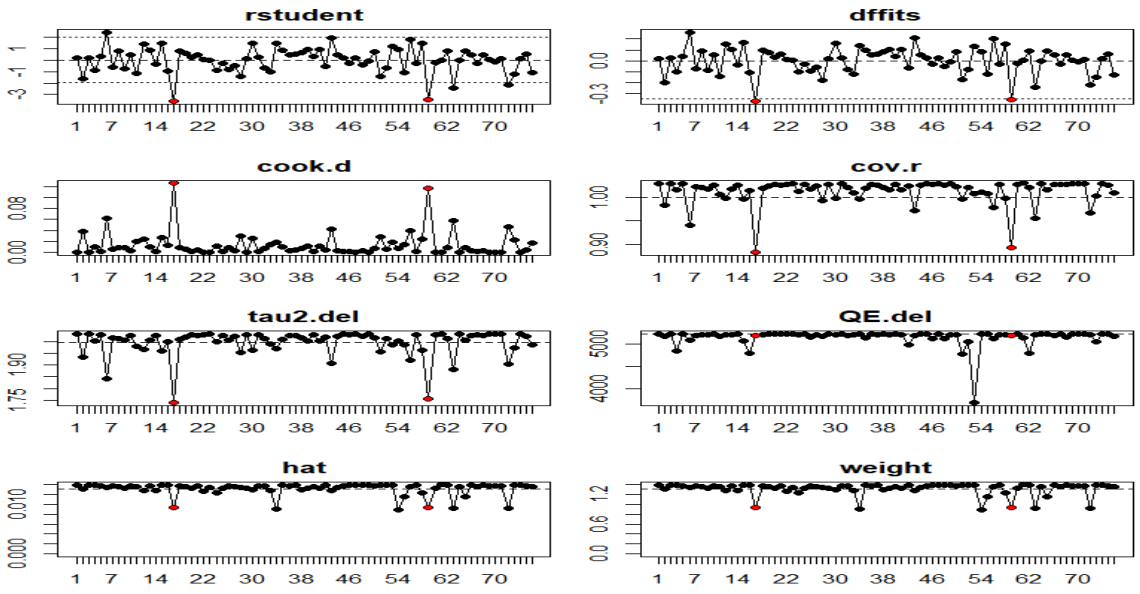


Figure 2. 3: Plot for examining outliers from the parental underestimate proportion of children with overweight and obesity via visual scale.

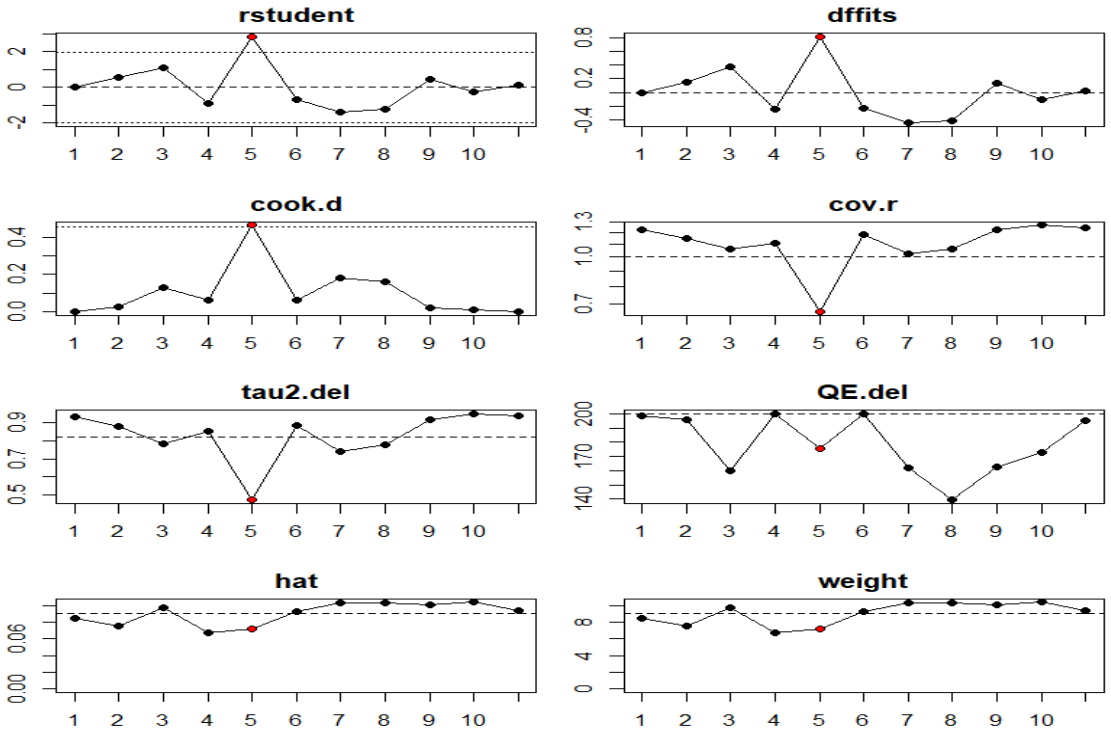
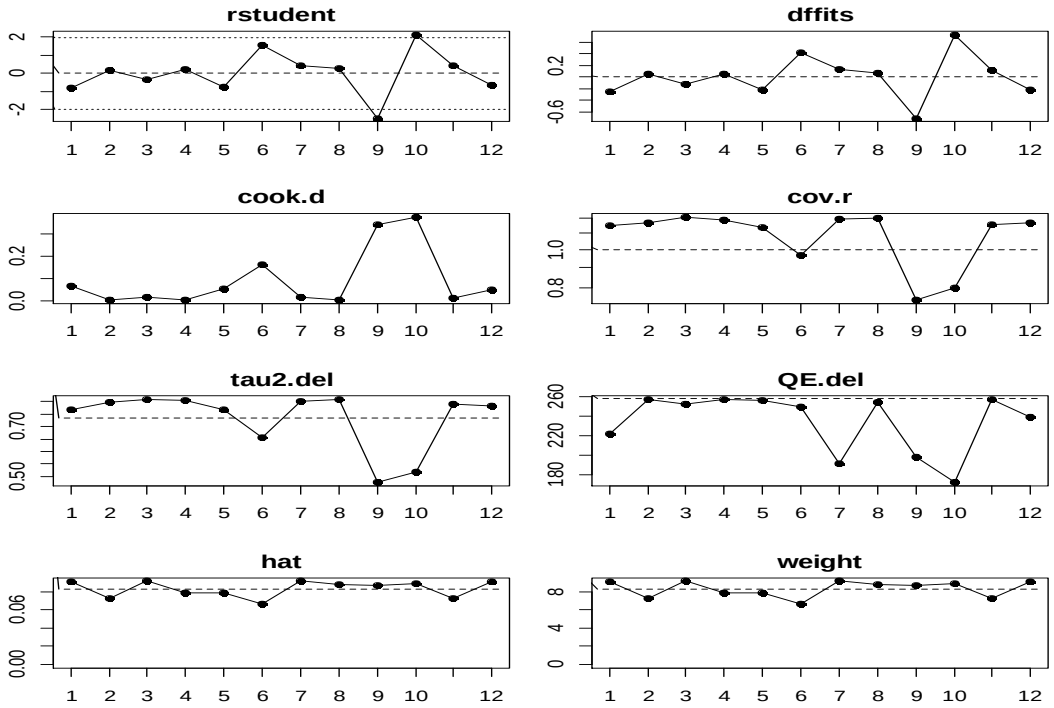


Figure 2.4: Plot for examining outliers from the children and adolescents underestimate proportion of their own overweight and obesity status via visual scale.



For evaluating heterogeneity among the studies, table 2.4 revealed that, for the studies assessing parental underestimation via verbal method, the τ^2 was 2.00 (95% CI=1.62 3.46), I^2 was 99.32% (95% CI: 99.17% 99.61%), and the *Q*-statistic was 5218 (p-value<0.001). For visual method, τ^2 was 0.82 (95% CI=0.35 3.21), I^2 was 97.06% (95% CI: 93.33% 99.23%), and the *Q*-statistic was 200.109 (p-value<0.001). For both methods, the I^2 was high, the test was significant, suggesting heterogeneity in the effect sizes between studies, and hence Random effects model was used(Figure). Whereas in the studies that evaluated children and adolescents' underestimation (table 2.5) the τ^2 was .73 (95% CI=0.33 2.27), I^2 was 97.42% (95% CI: 94.47% 99.15%), and the *Q*-statistic was 258.34 (p-value<0.001). Since I^2 was high, and the test was also significant, therefor, random effects model was used(figure).

Table 2.4: Homogeinity assessment for point estimates of effect sizes of parental underestimation of overweight and obese children's weigh in terms of Verbal and Visual Methods

	Verbal			Visual		
Statistic	Estimate	95%CI		Estimate	95%CI	
τ^2 (estimated amount of total heterogeneity)	2.00	1.62	3.46	.82	0.35	3.21
τ (square root of estimated τ^2 value)	1.41	1.27	1.86	0.91	0.59	1.79
I^2% (total heterogeneity / total variability)	99.32	99.17	99.61	97.06	93.33	99.23
Test for Heterogeneity:	*Q*-statistic= 5218.9705, p-value < .001			*Q*-statistic= 200.1098 p-value < .001		

Table 2.5 : Homogeneity Assessment for Point Estimates of Effect Sizes of Children Underestimation of their Overweight and Obesity

Statistic	Estimate	95%CI
τ^2 (estimated amount of total heterogeneity)	0.73	0.33 2.27
τ (square root of estimated τ^2 value)	0.86	0.58 1.51
I^2% (total heterogeneity / total variability)	97.42	94.47 99.15
Test for Heterogeneity:	*Q*-statistic=258.3483 p-value < .001	

After using the random effect size model, pooled effect size for the overall underestimation of child's weight status among parents in the studies used verbal scale revealed that 55% (95% CI 48%–61%)(see table2.6 and figure2.5), however, in the studies used visual scale, the overall pooled effect size was 47% (95% CI 36% 58%) (see table 2.7 and figure 2.6). For children and adolsecents, pooled effect sizes of their underestimation of their own overweight status was 34% (95% CI 25%–43%), which was stsatically signifcant (z=11.46, p-value<.001) (see table 2.8 and figure 2.7). Although there was

insufficient data to perform a meta-analysis, Spurrier *et al*. 2006, Chaimovitz *et al*.,2008 and Tarasenko, Rossen and Schoendorf 2014 reported that underestimation of overweight also applied to a significant number of HCP with a range of (20% -60%).

Table 2.6: Summary of Point Estimates of Effect Sizes of Parental Underestimation of Children with Overweight and/or Obesity Usingthe Verbal Assessment Method

Study	Estimate	95% CI	
Abbott *et al*, (2010)	0.61	0.57	0.64
Adams *et al*, (2002)	0.1	0.05	0.19
Akreman *et al*, (2007	0.62	0.56	0.67
Aljunibi *et al*, (2013)	0.27	0.24	0.3
Al-Mohaimeed *et al*, 2016)	0.65	0.56	0.73
Al-Qaudo *et al*, (2010)	0.97	0.95	0.98
Arcan *et al*, (2012)	0.33	0.25	0.42
Baughcum *et al*, (2000)	0.79	0.69	0.86
Bossink-Tuna *et al*,(2006)	0.29	0.16	0.44
Boutelle *et al*, (1998)	0.7	0.62	0.78
Brannon *et al*, (2007)	0.19	0.12	0.28
Campbell *et al*, (2006)	0.9	0.8	0.96
Carnell *et al*, (2005)	0.81	0.73	0.87
Chaimovitz *et al*, (2008)	0.43	0.22	0.66
Chaparro *et al*., (2011)	0.9	0.87	0.93
Chen *et al*, (2014)	0.25	0.23	0.28
Crawford *et al*, (2005)	0	0	0.02
de Hoog *et al*, (2012)	0.79	0.72	0.85
De La *et al*. (2009)	0.75	0.65	0.83

Eckstein *et al*. (2006)	0.64	0.49	0.78
Esenay *et al*. (2010)	0.71	0.63	0.78
Etelson *et al*, (2000)	0.58	0.33	0.8
Fisher *et al*, (2002)	0.56	0.41	0.7
Garrett-Wright *et al*,(2011)	0.24	0.08	0.47
Gauthier and Gance(2015)	0.45	0.3	0.61
Genovesi *et al*, (2005)	0.28	0.22	0.35
Guevara-Cruz *et al*,(2012)	0.38	0.27	0.5
Ha *et al*, (2010)	0.14	0.07	0.22
Hackie& Bowles, (2007)	0.61	0.43	0.76
Harnack *et al*, (2005)	0.91	0.82	0.96
He and Evans, *et al*,(2002)	0.63	0.53	0.72
Hearst *et al*, (2005-7)	0.31	0.23	0.4
Hudson*et al*, (2009)	0.21	0.09	0.39
Jackson *et al*, (1990)	0.94	0.71	1
Jansen & Brug, (2006)	0.8	0.76	0.83
Jonse *et al*, (2011)	0.69	0.6	0.77
Júlíusson *et al*, (2011)	0.71	0.67	0.75
Kasemsup and Reick,(2006)	0.77	0.6	0.9
Kaufman *et al*, (2012)	0.82	0.71	0.9
Kersey *et al*, (2010)	0.65	0.53	0.76
Kroke *et al*, (2006)	0.83	0.71	0.91
Lazzeri *et al*. (2006)	0.35	0.32	0.38
Lampard *et al*, (2005)	0.95	0.9	0.98
Laraway *et al*, (2010)	0.71	0.57	0.83
Lopes *et al*, (2012)	0.62	0.54	0.69

Lydecker and Grilo,(2016)	0.45	0.42	0.48
Molina de Faria *et al*,(2009)	0.61	0.55	0.67
Mamun *et al*, (2008)	0.4	0.36	0.44
Manios *et al*, (2003)	0.51	0.45	0.57
Mathieu *et al*, (2010)	0.77	0.71	0.83
Moschonis *et al*, (2011)	0.15	0.13	0.18
Maynard *et al*, (2003)	0.32	0.28	0.36
McKee *et al*., (2016)	0.86	0.85	0.87
Miller *et al*, (2007)	0.86	0.42	1
Moore *et al*, (2006)	0.19	0.04	0.46
Musaad *et al*, (2015)	0.94	0.91	0.96
Myers and Vargas,(2001)	0.45	0.38	0.52
Perrin *et al*, (2010	0.91	0.79	0.98
Petricevic *et al*, (2012)	0	0	0.02
Ra *et al*, (2016)	0.47	0.3	0.65
Robinson and Sutin,(2017)	0.55	0.54	0.56
Regber *et al*. (2003)	0.78	0.77	0.8
Rudolph *et al*, (2007)	0.02	0	0.11
Shrewsbury *et al*. (2012)	0.54	0.41	0.67
Skelton *et al*, (2006)	0.81	0.54	0.96
Tarasenko *et al*, (2014)	0.7	0.67	0.73
Tschamler *et al*, (2010)	0.46	0.33	0.59
Twarog *et al*, (2016)	0.7	0.68	0.73
Vanhala *et al*, (2004)	0.57	0.48	0.66
Vuorela *et al*, (2010)	0.51	0.41	0.6
Wald *et al*, (2004)	0.58	0.5	0.67

Webber *et al.*, (2010)	0.03	0	0.15
Wen and Hui, (2009)	0.18	0.14	0.23
West *et al.*, (2008)	0.6	0.57	0.63
Yao and Hillemeir, (2006)	0.72	0.64	0.79
Young-hyman *et al*,(2000)	0.21	0.13	0.3
Random pooled ES	***.55***	***.48***	***0.61***

Test of ES=0 : z= 24.14 p-value<.001

Figure 2.5 Forest Plot for the Summary of Point Estimates of Effect Sizes of Parental Underestimation of Children with Overweight and/or Obesity Using the Verbal Assessment Method

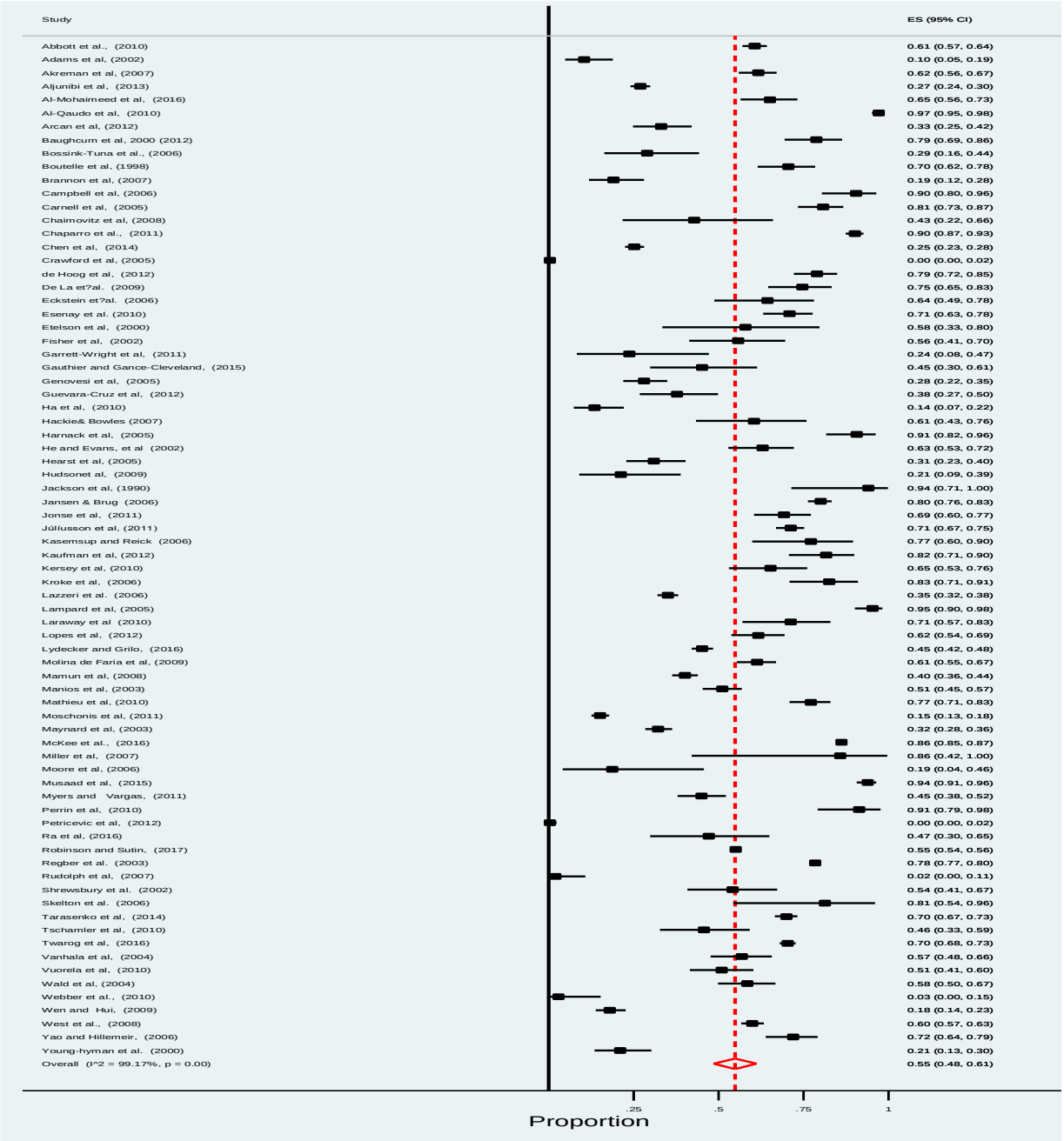


Table 2.7: Summary of point estimates of effect sizes of parental underestimation of children with overweight and/or obesity (visual assessment method)

Study	Estimate	95% CI	
Chaimovitz *et al*, (2008)	0.48	0.26	0.7
Duarte *et al*, (2016)	0.62	0.32	0.86
Hager *et al*, (2012)	0.7	0.58	0.79
Reifsnider *et al*, (2006)	0.25	0.05	0.57
Rosas *et al*, (2010)	0.91	0.76	0.98
Eckstein *et al*, (2006)	0.31	0.18	0.47
Maximova *et al*, (2008)	0.22	0.19	0.26
Lazzeri *et al*, (2006)	0.24	0.21	0.27
Wong *et al* (2013)	0.57	0.49	0.65
Moschonis *et al*, (2011)	0.41	0.38	0.45
Gauthierr and Gance (2015)	0.5	0.34	0.66
Random pooled ES	***.47***	***.36***	***0.58***

Test of ES=0: z= 11.94 *p*-value<.001

Figure 2.6: Forest Plot for the Summary of Point Estimates of Effect Sizes of Parental Underestimation of Children with Overweight and/or Obesity Using Visual the Assessment Method

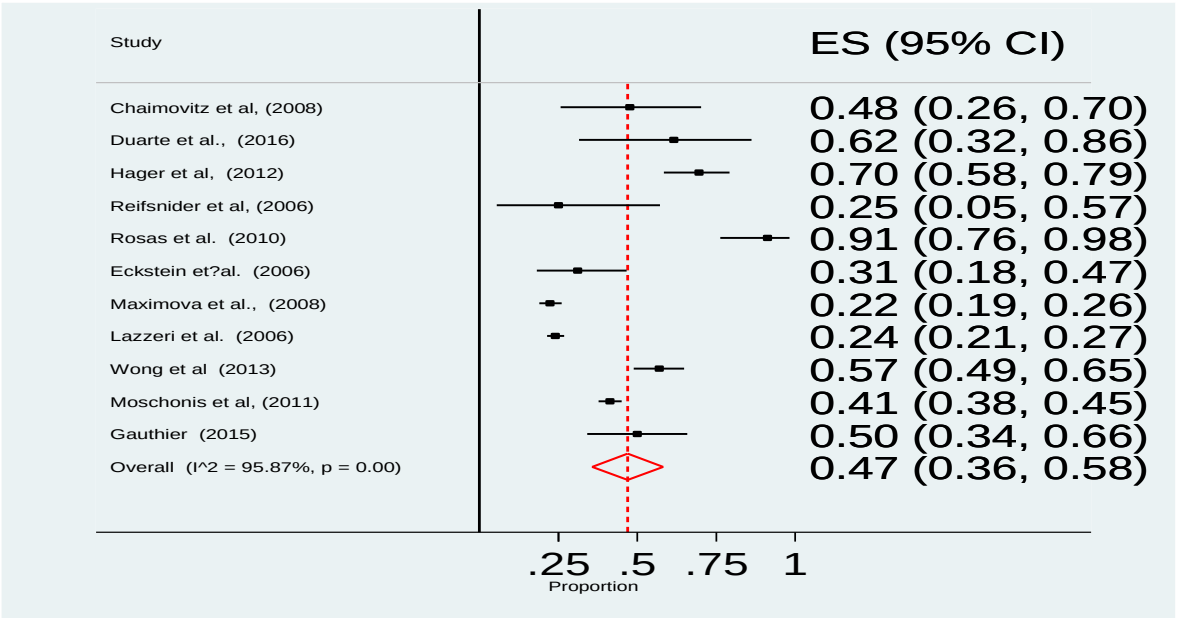
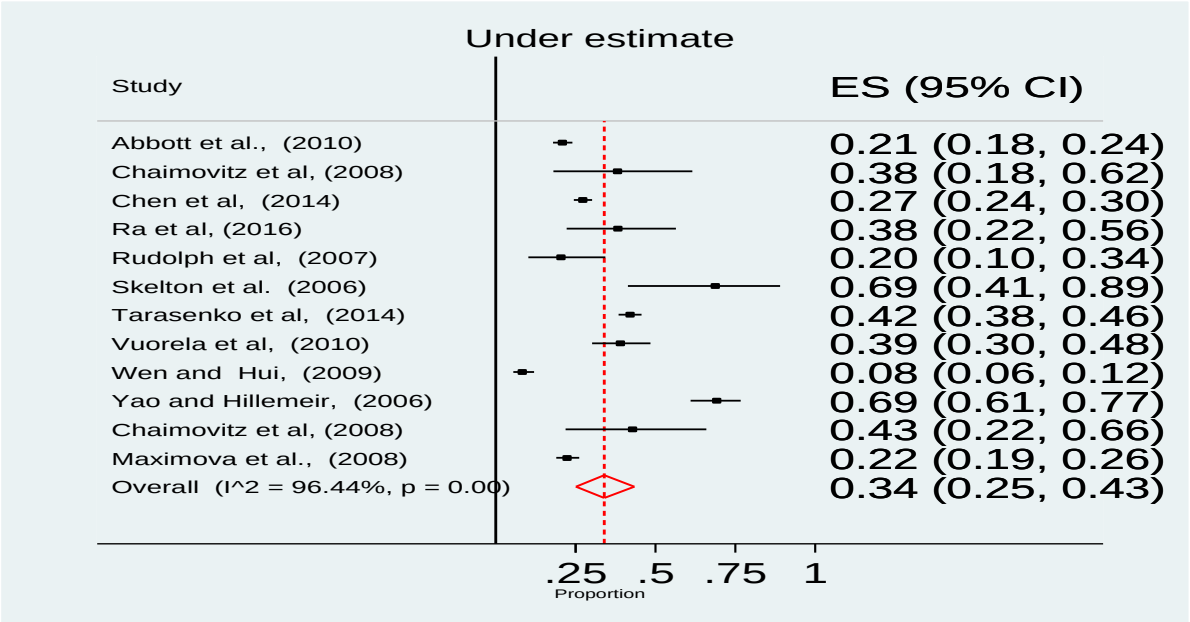


Table 2.8: Summary of point estimatesof effect sizes of parental underestimation of overweight and obese children's weigh based on children

Study	Estimate	95% CI	
Abbott *et al.*, (2010)	0.21	0.18	0.24
Chaimovitz *et al*, (2008)	0.38	0.18	0.62
Chen *et al*, (2014)	0.27	0.24	0.3
Ra *et al*, (2016)	0.38	0.22	0.56
Rudolph *et al*, (2007)	0.2	0.1	0.34
Skelton *et al*. (2006)	0.69	0.41	0.89
Tarasenko *et al*, (2014)	0.42	0.38	0.46
Vuorela *et al*, (2010)	0.39	0.3	0.48
Wen and Hui, (2009	0.08	0.06	0.12
Yao and Hillemeir,(2006)	0.69	0.61	0.77
Chaimovitz *et al*, (2008)	0.43	0.22	0.66
Maximova *et al.*, (2008)	0.22	0.19	0.26
Random pooled effect size	***.34***	***.25***	***0.43***

Test of effect size=0: z= 11.46 p-value<.001

Figure 2.7: Forest plot for the summary of point estimates of effect sizes of children underestimation of overweight and obesity



2.4 Discussion

The current systematic review and meta-analysis have statistically identified the prevalence of the underestimation of children's overweight statuses across a wide age range and across parents, children themselves and healthcare professionals. This review has shown that children's overweight status is frequently underestimated and is consistent with the earlier reviews in this area (Parry *et al.,* 2008; Doolen *et al.,* 2009; Rietmeijer-Mentink *et al.,* 2013; Lundahl *et al.,* 2014). However, this extends an analysis of these works with a meta-analysis that demonstrates that the majority of parents 55% underestimated their children's level of overweight verbally and 47% visually, while a substantial proportion of children underestimated their overweight status 34%. Healthcare professionals shared this misperception despite the low number of studies preventing a meta-analysis. This finding is in accordance with earlier literature, which shows that the overweight underestimation is also very common in adults (Chaimovitz *et al.,* 2008). The findings of this review are of concern if one accepts that alignment is required within the therapeutic triad for a trusting and concordant relationship (Chaimovitz *et al.,* 2008). When one or more parties enters conversations, minimizing or rejecting advice highlights the need for intervention, it is reasonable to suggest that tensions might arise unless time and consideration is paid to align the beliefs.

To the authors' knowledge, this is the first systematic review of this topic which considers ways in which features of study design might affect the prevalence of the underestimation of overweight status, in addition to study quality. This systematic review has addressed studies which used both a verbal scale (e.g., asking participants to complete a forced-choice rating scale whereby each response category was based on a medical weight standard) and/or a visual scale (e.g., selecting an image from a range of pictures or silhouettes [linked blind to BMI and weight status] that best represented the child's current size) but considered them separate for the meta-analyses. Across the literature, a wide range of terminology has been employed to label response options in verbal scaling. These differing labels, even

when the same criteria underpin the scaling, have the potential to be interpreted differently by participants. In addition, there is a sizeable evidence-base demonstrating that overweight adjectives, including medical terms, can lead to negative emotions (Carnell *et al.,* 2005; Doolen *et al.,* 2009; Puhl *et al.,* 2010). In the qualitative studies, parents commonly describe their children in terms other than obese, such as "big boned," "thick," and "solid," and demonstrate a strong desire to avoid labelling their child with medical terminology (Eli *et al.,* 2014). Perceived blame and internalized stigma may negativity generate resistance to the language of the discussion and may trigger reduced intention to engage in behaviour change (Chaimovitz *et al.,* 2008; Puhl *et al.,* 2010). The effect of this on our results is that the studies, which utilized terminology associated with negative emotion, might under-report the prevalence of overweight status and yet the majority of the included studies (n = 66) neglected to describe the questionnaire development process and failed to justify the weight-related terminologies used, even when in-paper references to previous uses of the questionnaire were consulted (n = 12).

Visual scales avoid the need for labelled response options and the issues involved in selecting neutral terminology (Chaimovitz *et al.,* 2008). However, the 13 studies using these methods are beset by the same variation in instruments (silhouettes, photographs etc.) as the methodology utilizing verbal scales. Studies which allow direct comparison suggest that visual scales are more accurate than verbal scales (Lazzeri *et al.,* 2006). In view of this consideration, studies using pictorial assessment methods for the views of parents and children result in a slightly less underestimation of overweight/obesity (47%) compared to the verbal scale (55%). This result may further suggest that parents and children as well as adolescents do recognize the weight status but do not verbally label it as overweight (Rietmeijer-Mentink *et al.,* 2013). This is perhaps because of the negative association with the word overweight and the stigma attached to people with obesity in society (Maynard *et al.,* 2003; Ruiter *et al.,* 2020). However, there is little evidence using pictorial assessment methods in the current review to make informed conclusions on it.

Despite the diversity in the study design discussed above, it is noteworthy that such a large number of studies from across the world, have investigated this phenomenon and the meta- analyses demonstrate such a clear effect. Any future studies investigating the prevalence of the underestimation of overweight status in children, particularly among caregivers, should be justified in the light of this. At this stage, more useful approaches could be applied in investigating family characteristics that are associated with overweight status underestimation as this review has suggested the influence of children's age especially the younger children, (Maynard *et al*. 2003; Crawford *et al.,* 2006; Eckstein *et al.,* 2006, Lydecker *et al*. 2016; Ruiter *et al.,* 2020; Rodrigues *et al.,* 2020), children's gender (male) (Maynard *et al.,* 2003; Abbott *et al.,* 2010; Vanhala *et al.,* 2011; Wen *et al.,* 2011; Lydecker *et al.,* 2016; Ruiter *et al.,* 2020; Rodrigues *et al.,* 2020). Children's current BMI (Maynard *et al.,* 2003; Abbott *et al.,* 2010; Vanhala *et al.,* 2011; Hager *et al.,* 2012; Duarte *et al.,* 2016), parental weight status, (Maximova *et al.,* 2008; Lydecker *et al.,* 2016; Rodrigues *et al.,* 2020), ethnicity (Molina *et al.,* 2009; Twarog *et al.,* 2016; Vrijkotte *et al.,* 2020) and parental education levels (Baughcum *et al.,* 2000; Genovesi *et al.,* 2005; de Hoog *et al.,* 2012; Rodrigues *et al.,* 2020; Vrijkotte *et al.,* 2020).

The way in which an individual perceives another individual is informed by their relationship, the perceived individual's characteristics, and the perceiving individual's characteristics. This is further compounded by their beliefs, and experiences which, in turn, influence their attitudes, thoughts, and feelings toward the perceived (Rietmeijer-Mentink *et al.,* 2013). A clear knowledge of the factors which may lead to inaccuracy in assessing child overweight status may help to pre-empt these “difficult” conversations, facilitate the recognition of children's overweight status and unify the therapeutic triad.

Jain *et al.,* (2001) report two important findings. Firstly, that the mothers of young children with overweight tended to assume that as their child aged, grew taller, and engaged in more physical activity, their child's weight status would improve and secondly, that continuous rises in weight and height were indicative of positive nutrition and parenting. Alongside this, Genovesi *et al.,* (2005) reported that for

some parents, overweight was considered a sign of good health. This may underpin why a child's overweight status is more likely to be underestimated by caregivers when the child is younger. Older children were found to be able to identify their own overweight status better compared to the parents of younger children (Abbott *et al.,* 2010). This could be caused by their own perception of their weight compared to their peers. A number of studies included in this review report that participants underestimate overweight status less among female children when compared to male counterparts (Etelson *et al.,* 2003; Maynard *et al.,* 2003; Vanhala *et al.,* 2011; Wen *et al.,* 2011; Lydecker *et al.,* 2016; Twarog *et al.,* 2016; Ruiter *et al.,* 2020; Rodrigues *et al.,* 2020). Drawing on a representative sample, one of the included studies reports that accurate identification of overweight status among mothers was three times higher for female children when compared to males (Maynard *et al.,* 2003). Similarly, Fisher *et al.,* (2002) found that while 67% of parents of overweight males do not recognize this status, the proportion was 44% for females. According to Campbell *et al.,* (2006) mothers have a higher sensitivity to female body image and weight considerations, while for overweight male children, their weight status may be perceived as physically advantageous. It is unfortunate that such a small proportion of the literature included male caregivers (n = 27) and for those that did, no direct comparisons were made.

A number of studies have found that a child's BMI plays a significant role in affecting underestimations of overweight status. Children with higher BMIs were more likely to be identified correctly as having an overweight status (Adams *et al.,* 2005; Maynard *et al.,* 2005; Parry *et al.,* 2008; Abbott *et al.,* 2010; Vanhala *et al.,* 2011; Hager *et al.,* 2012; Shrewsbury *et al.,* 2012; Duarte *et al.,* 2016). Therefore, children at the lower end of the overweight range (based on a BMI-for-age percentile) were more likely to be underestimated. This blurring at the overweight cut-off level accounts, perhaps, for norm-comparison in a society where higher BMIs are more common (Oldham and Robinson, 2016).

Maternal weight status was a variable considered in a number of studies (Mamun *et al.,* 2008; Lydecker *et al.,* 2016). Moschonis *et al.,* (2011) reported that the underestimation of child overweight status was 1.44 times more likely among mothers with overweight compared to mothers without overweight status. A study conducted by McPherson *et al.,* (2016) addresses this by suggesting that because parents with a high BMI have been subjected to social stigma, they are more likely than underweight and healthy weight parents to want to safeguard their children from the provoking labels associated with overweight status. However, Linchey *et al.,* (2019) found no association between parent weight status and underestimation. Despite the suggestion that lower levels of maternal education are associated with the underestimation of overweight in children (Baughcum *et al.,* 2000; Genovesi *et al.,* 2005; Hackie *et al.,* 2007; Hearst *et al.,* 2011; Linchey *et al.,* 2019; Rodrigues *et al*.2020; Vrijkotte *et al.,* 2020). There are some inconsistencies in the evidence by Adams *et al.,* (2005); He and Evans, (2007); Carnell *et al.,* (2009) suggesting no link between maternal educational levels and the underestimation of children's overweight status. In contrast, Ruiter *et al.,* (2020) found that the parents who had a high level of education were more likely to underestimate their child's overweight status. Hispanic and African American ethnicities were also positively associated with the overall underestimation of children's weight status in three studies (Twarog *et al.,* 2016; Molina *et al.,* 2009; Vrijkotte *et al.,* 2020). Molina *et al.,* (2009) found white children were less likely to be underestimated than non-white. The greater acceptance of larger body size in some cultures may account for these differences (Eli *et al.,* 2014). In addition, parental underestimation of children's overweight and obesity statuses has been reported to be particularly common among Hispanic individuals (Twarog *et al.,* 2016), an ethnic group with very high levels of overweight and obesity prevalence and a likelihood to identify larger body size as being more normal (Eli *et al.,* 2014). In the recent study by Linchey *et al.,* (2019), parent race/ethnicity was not associated with underestimating child weight status. However, this study is limited by unequal ethnic groups (White, Hispanic, Asian, black), with a small percentage of an African American sample

(3.4%) which makes it difficult to fully examine the associations by ethnicity. The study has found that there is much more work to be done to elicit the relationship between parents, child and healthcare professionals' underestimation of weight status. A greater focus on the factors associated with healthcare professionals' underestimation could provide a greater opportunity for a clearer understanding. Future studies could investigate additional factors such as the impact of male parents on their tendency to underestimate child overweight using multivariate study designs to allow a more complete and detailed description of any interactions between characteristics, and more consistent data collection methods with an emphasis on visual scaling.

This systematic review and meta-analysis is associated with a number of strengths and limitations. A key strength is that it includes both quantitative and qualitative studies, which allows greater and in-depth analysis and understanding. Over and above the existing knowledge in this area, the study sought to examine the perceptions of parents, children, and healthcare professionals. This review includes participants from a range of socioeconomic and cultural backgrounds, with a wide age range of children (up to 19 years old) in both experimental and population settings. However, an important limitation of this systematic review has been the lack of a statistical examination of healthcare professionals' perceptions, which stems from the scarcity of relevant studies in the literature. Additionally, gender-based disparities in the parental tendency to underestimate child overweight were not tested, since the majority of the included studies examined mother-to-child rather than father-to-child dyads. Lastly, the results could suffer from publication bias due to the fact that some of the unpublished studies were not included.

This systematic review's findings indicate that when the prevalence of underestimation of child weight status is acknowledged, viable interventions can be promoted which could involve both parents, the children, and healthcare professionals. For the purpose of raising awareness among the parents of children who are overweight and obese, it is necessary to ensure that healthcare professionals

themselves have an adequate understanding of these conditions. This could be facilitated if healthcare professionals are trained as well as engage directly with the various ways in which children and their parents define overweight, and to gain insight into the long-term consequential health factors of being categorized as overweight and obese (Towns *et al.,* 2009).

As emphasized by Puhl *et al.,* (2010) the psychological resistance that sometimes arises in parents due to the perceived link between childhood obesity, stigma, and blame, may result in their denial of a healthcare professional's diagnosis, which decreases their receptiveness towards proposed interventions. Hence, healthcare professionals should engage directly with concerns over stigma when discussing childhood overweight and obesity with parents, assuring them that they are not to blame for the condition, and that their participation in the cooperative management of their children's overweight condition represents a beneficial step forward. Additionally, healthcare professionals should refrain from engaging parents in such a way as to instill guilt or a sense of being judged. Lastly, the sensitive framing of each discussion regarding child weight status should be a top priority.

2.5 Conclusion

The results of this wide-reaching systematic review confirm that the underestimation of child overweight status is highly prevalent. In the quantitative studies, the underestimation of children's overweight was associated with some demographic factors (male gender, younger children, parental educational level and ethnicity), anthropometric factors (e.g. the current weight status of both the child and parents) and research methods (verbal vs. visual). In the qualitative studies, the parents demonstrated a strong desire to avoid labelling their child using medical terminology. Those that design child weight management interventions should expect that for many parents and children, identifying and problematizing their child's overweight status will be unexpected and possibly unwelcome and therefore possibly require extra consideration to align beliefs as this could lead to negative emotions and resistance. Although understanding the factors which lead to inaccuracy in assessing child's

overweight status may help to pre-empt “difficult” conversations and facilitate the recognition of children's overweight status, much work is required. Future studies could usefully consider understanding a wider range of parents/main carers, child and healthcare professionals’ characteristics, by utilizing multivariate study designs, and using more consistent data collection methods with an emphasis on visual scaling.

Chapter 3: Underestimation of overweight and obesity in adults: an investigation into the effect of fear of fat in personal evaluations

3.1 Chapter Introduction

The results of study 1 have demonstrated that a significant number of parents of children with overweight or obesity underestimate their children's overweight status. Children and healthcare professionals seem to also share the same misperception. Like parental underestimation, a considerable percentage of adults with overweight or obesity fail to identify themselves as being overweight (Oldham and Robinson, 2016). These results suggest that although overweight and obesity are highly prevalent among both children and adults, it is commonly underrecognized (Alshahrani *et al*., 2021; Robinson, 2017). The reasons for underestimation have been unclear. The way in which an individual perceives another individual is informed by their relationship, the perceived individual's characteristics, and the perceiving individual's characteristics, beliefs, and experiences (which, in turn, influence their attitudes, thoughts, and feelings towards the perceived individual) (Rietmeijer-Mentink *et al*., 2013). Therefore, in pursuit of the possible reasons for parental underestimation of child overweight and obesity, this chapter will further investigate the underestimation of self-perceived weight status among adults with overweight and obesity as well as the factors associated with this underestimation.

3.2 Introduction

Whilst researchers are fully aware of the increasing prevalence of overweight and obesity and the consequences, evidence suggests that individuals seem to underestimate overweight in others (Lundahl *et al.,* 2014; Robinson, 2017; Alshahrani *et al.,* 2021) and in personal evaluations e.g. (Kuchler

and Variyam, 2003; Yaemsiri *et al.,* 2010). Among UK adults, in a large nationally representative study, Oldham and Robinson, (2016), carried out a study to examine the weight perception of 6225 participants (45.2 % male, 54.8 % female) with a mean age of 49.4 years. The results of this study indicate that a significant number of individuals with overweight, 55% of adult men and 31% of women, systematically underestimate their weight status and categorize their weight as healthy or 'about right'. Similar findings were reported in a study based in the USA, this study used the 1999-2006 National Health and Nutrition Examination Survey and show that around 38% of adult participants with overweight and 8% of participants with obesity underestimated their weight status to be 'underweight' or 'about the right weight' (Dorsey *et al.,* 2009). In Australia, the weight perceptions of 2535 adult participants were examined. Approximately 50% of the adult participants who were classified as overweight and/or obese did not consider that their current weight was a health risk (Vandelanotte *et al.,* 2011). In the same year, a study by Yaemsiri *et al.,* (2011) examined 16720 of US adult participants from the 2003 to 2008 National Health and Nutrition Examination Survey. It was found that a significant number of individuals with overweight, 48% of men and 23% of women, also underestimated their overweight status and categorized their weight as healthy or 'about right'. Weight underestimation is very common among self and parental, lay people and medical practitioners (Robinson, 2017; Alshahrani *et al.,* 2021) yet much uncertainty still exists about why underestimation occurs.

It has been suggested that these misperceptions are significantly influenced by a range of sociodemographic, anthropometric, health and psychological characteristics. Previous published studies indicated that women with overweight are substantially less likely to underestimate their weight status compared to men with overweight (Johnson *et al.,* 2008; Jones *et al.,* 2010; Yaemsiri *et al.,* 2011). Across several studies, ethnic-minority status was associated with underestimation of overweight status (Dorsey *et al.,* 2003; Kuchler *et al.,* 2003), awareness of guidelines (Steenhuis *et al.,* 2006), higher socioeconomic status and higher educational attainment are protective against underestimation of

overweight status among individuals with overweight and obesity (Paeratakul *et al.,* 2002; Dorsey *et al.,* 2003; Johnson *et al.,* 2008; Miller *et al.,* 2008; Alwan *et al.,* 2010 Robinson, 2017). Furthermore, it has been suggested that these misperceptions are significantly influenced by bodyweight norms (Robinson, 2017). These studies examined how exposure to the heavy body weight of unknown others can result in underestimation of own weight status (Oldham and Robinson, 2016). Other studies show that weight perception can be influenced by beliefs about 'average' body sizes (Robinson and Kersbergen, 2017). However, these studies focused on perceptions about unknown others, yet it is still unknown if these visual norm explanations are also linked with personal and parental underestimation of overweight which will be explored in the current study and study 3 of this thesis.

Obesity is a sensitive issue because it is associated with stigma. Negative emotions of being labelled as "fat" or ''obese'' are highly stressful, and this leads to a greater risk of depression, anxiety, and low self-esteem (Hunger *et al.,* 2014). Previous studies have shown that medialised terms such as "overweight" or ''obese'' are consistently considered undesirable (Hirschfeld-Dicker *et al.,* 2018). The concept of "fear of fat" (a fear of obesity diagnosis) may stem from a desire to avoid the stigmatization that people with overweight/obesity face (Ackard *et al.,* 2002; Dalley and Buunk, 2009). In other words, there is a conscious and subconscious effort to escape or avoid the discrimination that people who are larger in weight experience. So far, however, no research has been found that surveyed the association between these negative emotions associated with obesity diagnosis and the underestimation of overweight status. Hence the importance of this study. Hence the importance of this study.

In the context of weight related communications and weight stigma, previous studies in this area have emphasised the roles of both experienced weight stigma (e.g., receiving nasty comments from others) and internalized weight bias (e.g., beliefs that negative weight stereotypes apply to the self) in weight related guilt and shame and healthcare avoidance (Amy *et al.,* 2006; Pausé, 2014). Despite the

importance of weight stigma on weight related communications, there remains a paucity of evidence on the association between body weight perceptions and both experienced weight stigma and internalized weight bias. These types of stigma are important in the area of weight related communication as it may contribute to healthcare avoidance and a reluctance to seek weight related help and support (Drury and Louis, 2002). The current study explores the association between (weight stigma experience and weight bias internalisation) and weight perceptions of own body weight perceptions.

As mentioned earlier, biases operate when evaluating bodyweight status and social norms are significantly implicated. The public health implications of this have been well described, namely education to adjust beliefs about acceptable body size in others and in personal evaluations (Robinson, 2017). However, caution is also expressed regarding the potential of further stigmatizing a person with value-laden negative self-beliefs, particularly in light of the finding that perceiving oneself as overweight is predictive of an increased number of weight loss attempts that get associated with weight gain overtime (Haynes *et al.,* 2018).

Therefore, the focus of this study is to empirically investigate the demographic, anthropometric and research method factors associated with the underestimation of self- perceived weight status. In addition, the study attempts to empirically investigate the association between fear of fat or the negative association with obesity diagnosis and the underestimation of overweight and obesity in personal evaluations. Furthermore, it seeks to contribute to the existing literature on social norms and to examine exposure to obesity and perceptions towards an average body size and its association with the underestimation of overweight status. Finally, it aims to examine the association between (weight stigma experience and weight bias internalisation) and body weight perceptions.

Main hypothesis

Individuals who have high levels of negative emotion associated with obesity diagnosis (fear offat) will be more likely to underestimate their overweight status.

Objectives

1. To empirically investigate the demographic, anthropometric and research method factors associated with underestimation of own overweight status.
2. To empirically investigate the effect of fear of fat or the negative association with obesity diagnosis on the underestimation of overweight and obesity in personal evaluation.
3. To contribute to the existing literature on social norms and to investigate the association between exposure to obesity and adult personal underestimation of overweight status.
4. To examine perceptions about an average body shape in both gender and underestimation of own overweight status.
5. To examine the association between weight stigma experience and weight bias internalisation and body weight perceptions.

3.3 Methodology

The methodology and research methods adapted and utilised in this study will be comprehensively described in this section. The benefits and drawbacks of the research tool selected will be outlined as part of the research design section following the explanation of research approach selected. Subsequently, the capacity of such methods to meet the research objectives and goals of the paper will be explored. This section is followed by an examination of the data analysis methods that have been utilised. Finally, the section will reach its conclusion by discussing the issues encountered

during the research as well as the limitations experienced in applying the research methodology and any relevant ethical considerations.

3.3.1 Research Approach

Abawi *et al.,* (2008) state that phenomena are explicated through the manipulation of observations and numerical representations that mirror such phenomena. These research approaches are all forms of quantitative research. The implementation of empirical statements and empirical methods within social research is another definition for quantitative research (Cohen, 1980). In the same vein, instead of a descriptive statement outlining what should be the case, an empirical statement outlines in the real world what the actual case is. Generally, the implementation of empirical evaluations occurs in quantitative research where numerical terms often represent such empirical statements. To what extent a certain policy or program does or does not achieve a certain norm or standard is assessed via the form defined as empirical evaluations. Additionally, especially relevant in the context of statistics, methodologies based on mathematics serve as the basis for the analysis of collected numerical data that all combine to explicate phenomena, as per another definition of quantitative research (Creswell, 2017). In the context of the current study, quantitative research methods may be well-suited for investigating people's perceptions of their weight as it allows for a large sample size, provide a more objective way of measuring perceptions of weight, allow for the use of statistical analysis to identify patterns and relationships in the data, enable comparisons among different groups of people, and are designed to be replicated. All of these factors make quantitative research methods more accurate and reliable understanding of people's perceptions of their weight.

3.3.2 Research design

With empirical evidence and theoretical guidelines serving as a basis, the quantitative research

strategy employed in this paper enables relationships between variables to be predicted while also highlighting any existing correlations, thus, demonstrating the compatibility of the hypothesis with the quantitative research methods. A paid recruitment service that took place via the website www.surveymonkey.com enabled the undertaking of an online, confidential, self-reported cross-sectional survey. Anonymously, participants who met the study eligibility criterion were randomly invited by the SurveyMonkey Audience panel (which includes more than 1 million members). Before self-administering the English-language survey, participants read and acknowledged a consent document. The survey took approximately 15 minutes to complete. A UK-based study looking at body shape and body weight was the description given for the survey (see Appendix B). In order to address the research questions and objectives, a large potential sample of around 2000 people was planned to be recruited, thereby providing the necessary variance and quantity to carry out the required statistical evaluations. Every potential participant, invited to take part in the survey, was over 18 years old and supposed to be a resident within the United Kingdom.

3.3.3 Instrument Design

Using such an online survey tool may have strengths and limitations. When comparing an online tool to the traditional methods of data collection such as face to face interviews, telephone surveys, and emails, this online survey is a very efficient and inexpensive way to receive large survey data (Heen *et al.,* 2014). As Greener, (2002); Silverman, (2004) and Bell *et al.,* (2018) stress, a principal limitation when performing large-scale studies is time, especially when there are multiple questions and research objectives to address. Thus, this paper was able to avert such limitations and collect data and connect with numerous respondents within roughly a couple of months via enacting the fast and efficient methodology of delivering a questionnaire. Another limitation may be related to a possible 10% error rate and sampling biases as a result

of distinct characteristics of the internet respondents (Heen *et al.,* 2014). Notwithstanding these limitations, previous studies have revealed several advantages to the use of web-based surveys. These advantages include, offering clear guidelines on how to answer survey questions, easy to distribute and access, offers a wide range of features that can be used to enhance the quality and effectiveness of research, such as randomized assignment and data visualization options. (Aerny-Perreten, *et al.,* 2015), an avoidance of possible data entry and coding errors during the process (Van Gelder, Bretveld, and Roeleveld, 2010). Given these advantages, using SurveyMonkey in the current study helps the researcher to export data in several formats and as a result facilitate management of large data and statistical analysis.

Some questions for this survey have been developed and modified by the author from unpublished study by the research team (e.g questions about height and weight, age, gender and ethnicity) and other questions have been adapted from previous related research projects (e.g. Robinson, 2016). In the survey, the participants were asked to provide self- reported data on a range of sociodemographic, anthropometric, health and psychological characteristics. The participants were unable to return to the questions they had already answered. Skip logic was used in this online survey to personalise consecutive items (e.g., gender), in order to minimize the survey time and length needed to finish the survey. The participants were asked about their socio- demographics: gender, age, highest level of education and ethnicity. They were asked ''what is your gender?''(female, male, non-binary / other, I would rather not say)''. The participants were also asked about their age and were categorized into four groups (18 – 24 years, 25 – 44 years, 45 – 74 years and 75+ years). Educational level was determined by asking participants ''What is the highest level of education you have completed?''. The participants were able to choose from the following answers ''No formal qualifications'', ''GCSE or equivalent'', ''A level or equivalent'', ''Undergraduate degree or equivalent (e.g., BSc, BA,

etc.)'', ''Postgraduate degree or equivalent (e.g. PGCert, MSc, PhD, etc.)''. The participants were also asked ''Which of the following best describes your ethnic origin?'' ''White (British, Irish, Other White)'', ''Black and Black British (Black Caribbean, Black African, Other Black)'', ''mixed (White and Black Caribbean, White and Black African, White and Asian, Other mixed)'', ''Asian and Asian British (Indian, Pakistani, Bangladeshi, Gujarati, Tamil)'', ''Other Asian, Chinese and Other Ethnic Groups (Chinese, Korean) and other ethnic group''. All statistical analyses were performed using IBM SPSS Complex Samples Statistics version 20. Logistic regression analysis was conducted to investigate if individual age and educational level predicts underestimation of own weight status.

Anthropometric Measures

In terms of the anthropometric data, weight and height were self-reported in whichever metric the individual preferred i.e. "How much do you weigh? (in kg and stone/lbs)'', ''What is your height? (in cm and feet/inches)". All imperial data was converted to metric units and BMI was calculated using the formula (kg/m²). The participants were divided into weight groups using weight the classification based on the World Health Organisation (WHO, 2000) definitions for BMI (underweight when their BMI is less than 18.5kg/ m², healthy weight when their BMI is equal to 18.6-24.95kg/m², overweight when their BMI is between 25-29.95kg/m² and obese when their BMI is higher than 30.0kg/m².

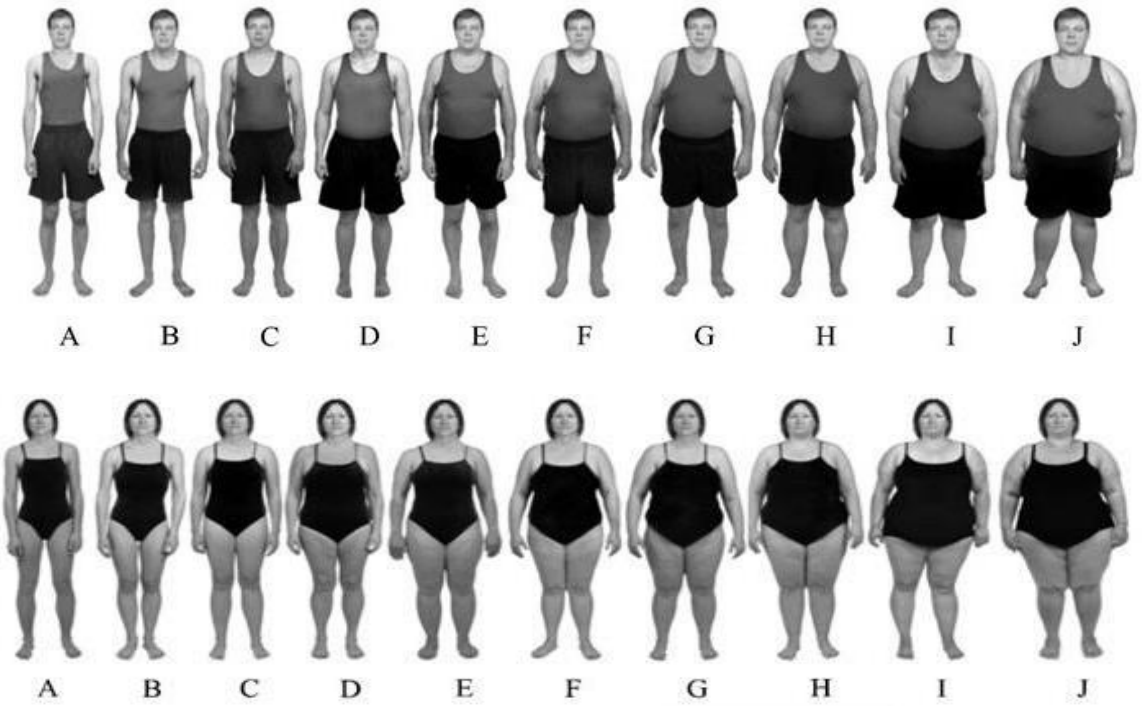
Weight Perception

Perceived weight was measured by using verbal and visual instruments. The participants' perceived weight status was compared to the calculated BMI category of each participant 'underweight, healthy, overweight and obese'. The participants were distributed into three weight perception categories (underestimation) participants who perceived their weight statusbelow their calculated

BMI, (accurate) participants who perceived their weight status correctlyusing their calculated BMI, (overestimation) participants who perceived their weight status above their calculated BMI.

In the verbal assessment, the participants were asked, “According to these widely used medical criteria, would you say that (at the moment) your weight can best be described as: Underweight, Healthy weight, Overweight, Obese’’. In the visual scale, the participants were asked to select which figure best represents their current body weight, “Which figure best describes your present body shape/size?”. These figures (Figure 3.1) were created by Harris *et al*., (2008) as a novel visual method for evaluating perception of weight status and have been evaluated for test-retest reliability and validity. This study utilized these figures to identify body weight norms associated with the underestimation of weight status as well as to evaluate people’s views of weight status in both the self and others.

Figure 3.1 Silhouettes developed by Harris *et al*., (2008) as a novel pictorial method for assessing perception of weight status.



Bodyweight Norms (adapted from Oldham and Robinson, 2016)

Exposure to Obesity

To test whether exposure to higher weight leads to a greater underestimation of obesity, participants were presented with the same visual assessment scale (Harris *et al*., 2008). This validated rating scales consisting of photographs of 10 standardized human body images of increasing BMI, ranging from underweight to class III obesity (Figure 3.1) were shown to participants and they were asked "For men/women, please select all those body shape/size that you normally see in everyday life?". The Pearson correlation formula was used to statistically measure the relationship between both verbal and visual weight perceptions and exposure to obesity. To determine whether there were any statistically significant differences between the means of each group the one-way ANOVA test was used.

Perceptions of Average Body Shape

To measure perceptions of average body size the participants were also shown male and female body size guides, as previously shown (Figure 3.1), and they were asked "Which Figure best describes an average body shape/size for men/women your age?". The Pearson correlation formula was used to statistically measure the relationship between both verbal and visual weight perceptions of overweight status with exposure to obesity. To determine whether there were any statistically significant differences between the means of each group, a one-way ANOVA test was used. *Post hoc* test was applied to investigate the differences between the group means when an analysis of variance (ANOVA) F test is significant.

Weight Stigma Experience and Weight Bias Internalization

To determine weight stigma experience, the Stigmatizing Situations Inventory (SSI) (Friedman *et al*., 2008) was used. This scale covered questions about e.g. physical limitations, receiving nasty comments from others, children, families or doctors, being avoided, excluded or ignored

based on the weight status. The scale has good reliability and validity. The data was coded as per the author's directions, and a mean score was calculated. Scores range from 1-6 with higher scores suggestive of greater experience of weight stigma. A Pearson correlation formulawas used to statistically measure the relationship between both verbal and visualmisperceptions of overweight status with weight stigma experience. To determine whether there are any statistically significant differences between the means of each group, a one-wayANOVA was used. If the result was statistically significant, in order to investigate the source of the differences, the *Post hoc* test was applied.

To investigate 'Weight Bias Internalisation', the scale developed by Pearl and Puhl (2014) was used. This scale (WBIS M) has good reliability and validity (Pearl and Puhl, 2014; Pearl and Puhl, 2018) and builds on an original version the (WBIS) developed by Durso and Latner (2008). This scale is used to assess the degree to which an individual applies weight-related stereotypes to themselves and base their self-evaluations on weight e.g. statements like 'Because of my weight, I feel that I am just as competent as anyone; I am less attractive than most other people because of my weight; I feel anxious about my weight because of what people might think of me' (Pearl and Puhl, 2014). The data was codded as per the authors' directions, and a mean score calculated. Possible scores range from 1-7 with higher scores suggestive of greater internalised weight bias. A Pearson correlation formula was used to statistically measure the relationship between both verbal and visual misperceptions of overweight status with internalised weight stigma. To determine whether there are any statistically significant differences between the means of each group, a one-way ANOVA test was used. If the result was statistically significant, and to investigate where the differences truly came from, the *Post hoc* test was to be applied.

Fear of Fat (negative emotions associated with obesity diagnosis)

To determine the effect of fear of fat (negative emotions associated with being categorized as obesity) on the underestimation of overweight and obesity in adults, a 'Fear of Obesity' scale has been developed by researchers (Goldfarb *et al*. 1985; Crandell, 1994; Lillis and Hayes 2008). Previous research (Swift and Bird, unpublished) has demonstrated that this 10 - item scale has a Cronbach's Alpha of 0.83. The data obtained was recoded as per the authors' instructions, and a mean score calculated. Possible scores range from 1-10 with higher scores indicative of greater fear of being identified as obese. A Pearson correlation formula was used to statistically measure the relationship between both verbal and visual misperceptions of overweight status with negative emotions associated with being categorized as obese. To determine whether there are any statistically significant differences between the means of each group, a one-way ANOVA was used. If the result was statistically significant, in order to investigate the source of the differences, the *post hoc* test was applied.

3.3.4 Ethical Approval

This study was approved by the School of Sociology and Social Policy, The University of Nottingham (BIO-1819-003). There were several types of ethical issues, which the researcher had to take into consideration for this project. The most important one was related with the informed consent of the participants. All of the participants were informed in advance about the purposes of this project and gave their informed consent to participate (see Appendix A) for participants information sheet). The participants were informed that the information provided would be stored securely and treated confidentially in accordance with the University of Nottingham GDPR policy (further details of which can be found at: https://www.nottingham.ac.uk/governance/documents/data-protection-policy-approved.pdf). Only researchers from the University of Nottingham would see the data and

that the data was be stored electronically, adhering to the university's data protection guidelines. The participants were also informed that anonymity was not guaranteed if the participants disclosed any illegal activities or if there is disclosure or evidence of significant harm, abuse, neglect or danger to themselves or others.

3.4 Results

Sample demographics

The online survey was completed by 1221 respondents. The demographic details of the sample are shown in Table 3.1. The sample was predominantly white (n=1028, 84.2%) with the following gender balance, women (n=587, 48.1%) and men (n=584, 47.8%).

Table 3.1 Sociodemographic and personal characteristics of the study population

Characteristics	n	%	Characteristics	n	%
Age			Gender		
18 - 24 years	134	10.3	Female	587	48.1
25 - 34 years	276	22.2	Male	584	47.8
35 - 44 years	266	21.9	Non-binary / other	3	0.2
45 - 54 years	230	19	I would rather not say	3	0.2
55 - 65 years	162	14	Total	1177	96.4
65 - 74 years	89	9	Missing data	44	3.6
Total	1177	96.4	Total	1221	100
Missing data	44	3.6			
Total	1221	100			
Ethnicity	n	%	Health	n	%
Other (please specify)	4	0.3	Excellent	113	9.3
White (White British, Irish, other White)	1028	84.2	Very good	282	23.1
Black and Black British (BlackCaribbean, Black African, Other Black)	27	2.2	Good	451	36.9
Mixed (White and Black Caribbean, White and BlackAfrican, White and Asian, Other mixed)	23	1.9	Fair	260	21.3

Asian and Asian British (Indian, Pakistani, Bangladeshi, Gujarati, Tamil, Other Asian)	73	6	Poor	71	5.8
Chinese and Other EthnicGroups (Chinese, Korean, Other ethnic group)	14	1.1	Total	1177	96.4
Rather not say	8	0.7	Missing data	44	3.6
Total	4	0.3	Total	1221	100.0
Missing data	44	100			
Total	1221	100.0			
Region in the UK	n	%	Education	n	%
East Midlands	101	8.3	No formal qualifications	43	3.5
East of England	92	7.5	GCSE or equivalent	306	25.1
London	162	13.3	A level or equivalent	319	26.1
North East	42	3.4	Undergraduate degree or equivalent (e.g. BSc, BA, etc.)	380	31.1
Northern Ireland	17	1.4	Postgraduate degree or equivalent (e.g. PGCert, MSc, PhD, etc.)	129	10.6
North West	143	11.7	Total	1177	96.4
Scotland	87	7.1	Missing data	44	3.6
South East	167	13.7	Total	1221	100
South West	94	7.7			
West Midlands	107	8.8			
Wales	53	4.3			
Yorkshire and the Humber	112	9.2			
Missing data	44	3.6			
Total	1221	100.0			

Anthropometric data

Height and weight were provided by N= 1061 respondents. N=160 were missing due to N=44 missing, N=55 both weight or height not provided or N=49 there was inconsistency between imperial and metric units and N=12 participants reported weight and height data that produced an implausible BMI and therefore data were excluded from subsequent analysis.

Based on mean calculated BMI was (26.8%) (6.67 SD). From the whole sample 5.8% were categorized as underweight, 33% were categorized as healthy weight, 37% were categorized as overweight and 24% were categorized as obese. Data are presented in (Table 3.2).

Table 3.2 Weight status based on Self-reported Body Mass Index

Objective weight status based on (WHO,2000)	Male n	Female n	Total Sample N	%	Mean	SD
Underweight (BMI <18.5)	30	32	62	5.8%	31	1.414214
Healthy weight (BMI 18.5–24.9)	156	196	352	33.2%	176	28.28427
Overweight (BMI 25–29.9)	230	165	395	37.2%	197.5	45.96194
Obese (BMI ≥30)	117	135	252	23.8%	126	12.72792

Body weight perceptions based on verbal and visual scales

The participants were generally accurate at identifying weight status. When using the verbal assessment method, 58.8% (n=624) of the participants correctly identified their body weight, 34.8% (n=369) of participants underestimated their body weight and 6% (n=86) overestimated (Table3.3 and Figure 3.2). The respondents were also asked to indicate which image best represented their current body weight and, in this situation, 17.6% (n=187) of participants underestimated their body weight, 56.3% (n=597) were accurate and 26.1% (n=277) overestimated (see Table 3.4 and Figure 3.3).

Table 3.3 Verbal weight perceptions

Weight based on calculated BMI	Verbal weight perceptions N=1061		
	Underestimation	Accurate	Overestimation
Underweight	0 (0.0%)	33 (53.2%)	29 (46.8%)
Healthy weight	35 (9.9%)	285 (81%)	32(9.1%)
Overweight	168 (42.5%)	220 (55.7%)	7 (1.8%)
Obese	166 (65.9%)	86 (34.1%)	0 (0.0%)
Total	369 (34.8%)	624 (58.8%)	86 (6.4%)

Figure 3.2 Verbal weight perceptions

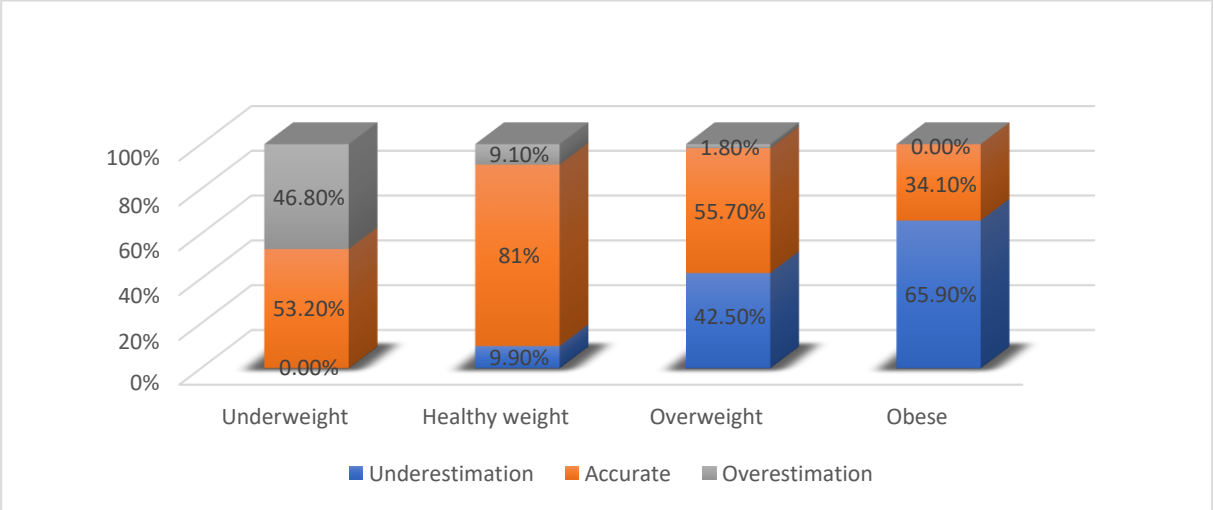
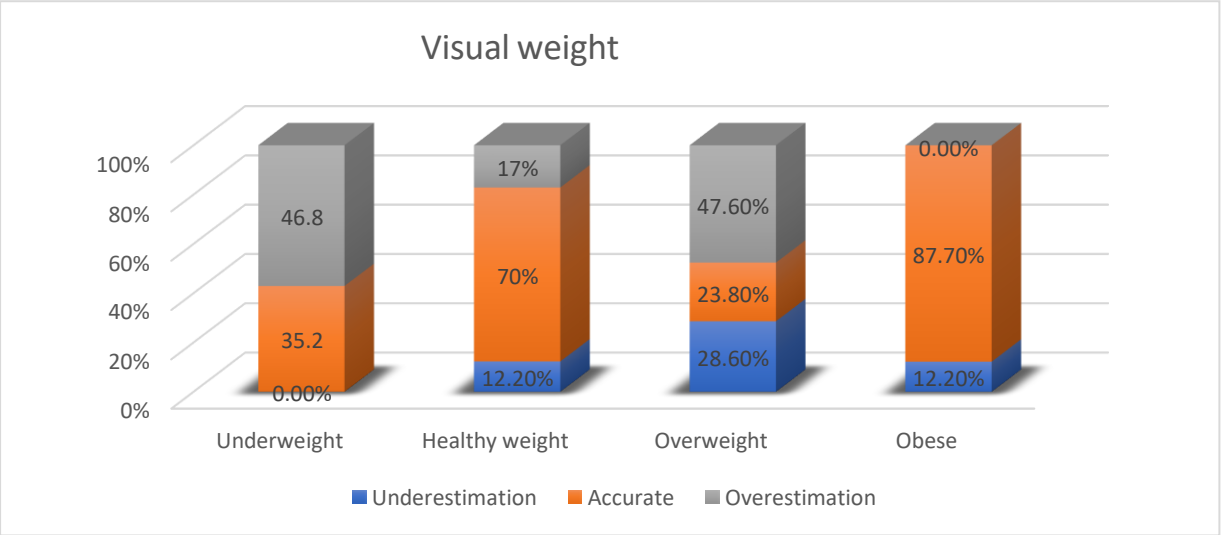


Table 3.4 Visual weight perceptions

Weight based on calculated BMI	Visual weight perceptions N=1061		
	Underestimation	Accurate	Overestimation
Underweight	0 (0.0%)	33 (35.2%)	29 (46.8%)
Healthy weight	43 (12.2%)	249 (70%)	60 (17%)
Overweight	113 (28.6%)	94 (23.8%)	188 (47.6%)
Obese	43 (12.2%)	221 (87.7%)	0 (0.0%)
Total	187 (17.6%)	597 (56.3%)	277 (26.1%)

Figure 3.3 visual weight perceptions



Demographic factors associated with the underestimation of overweight status in self-perceptions

Gender

As shown in Table 3.5 and Figure 3.4 when using the verbal scale, males were more likely to underestimate their weight than females (43.6% vs 25.8%). In visual estimations, Table 3.6 and Figure 3.4 illustrated that both genders were almost the same (16.1% vs 19.1%).

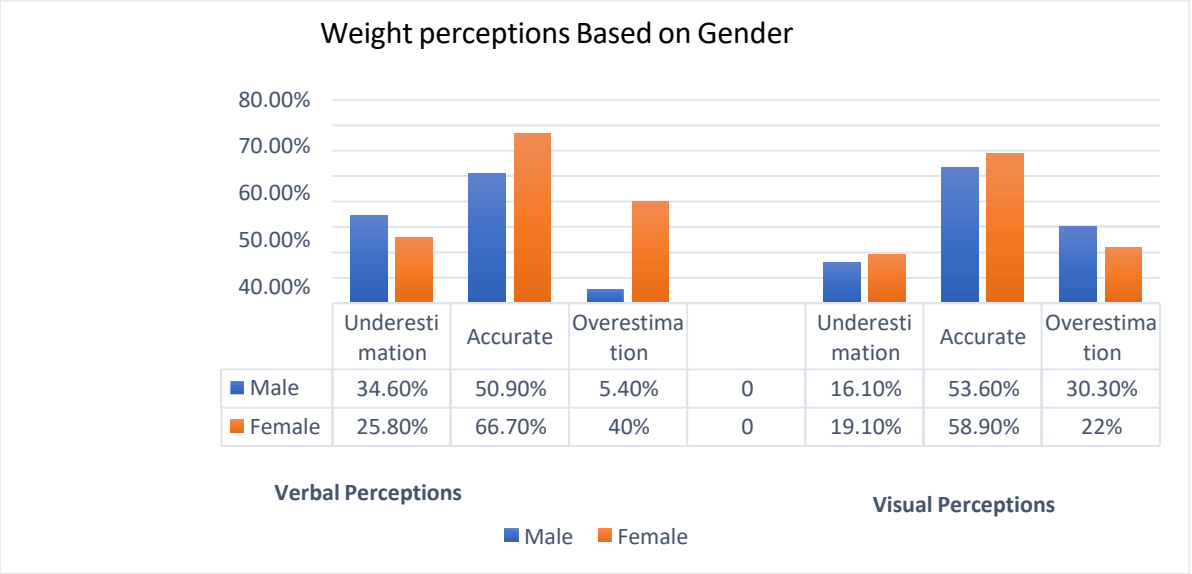
Table 3.5 Verbal weight perceptions-based on gender

Gender	Underestimation	Accurate	Overestimation	Total
Male	233 (34.6%)	272(50.9%)	29 (5.4%)	534(100%)
Female	136 (25.8%)	352 (66.7%)	7.6 (40%)	528 (100%)
Total	369 (34.7%)	624 (58.8%)	69 (6.5%)	1061 (100%)

Table 3.6 Visual weight perceptions -based on gender.

Gender	Underestimation	Accurate	Overestimation	Total
Male	86 (16.1%)	286 (53.6%)	162 (30.3%)	534(100%)
Female	101 (19.1%)	311 (58.9%)	116 (22%)	528 (100%)
Total	187 (17.6%)	597 (56.2%)	278 (26.2%)	1061 (100%)

Figure 3.4 Verbal and visual weight perceptions based on gender



Age

The results shown in Table 3.7 indicate that when using Pearson Correlation, a negative correlation between participants' age and weight perceptions was observed. Table 3.8 summarizes the relationship between different age groups and weight perceptions and illustrates how adults aged between 55 years-74 years underestimate weight status. Figure 3.5 compares weight perceptions between different age groups.

Table 3.7 Pearson correlation between age and weight perceptions

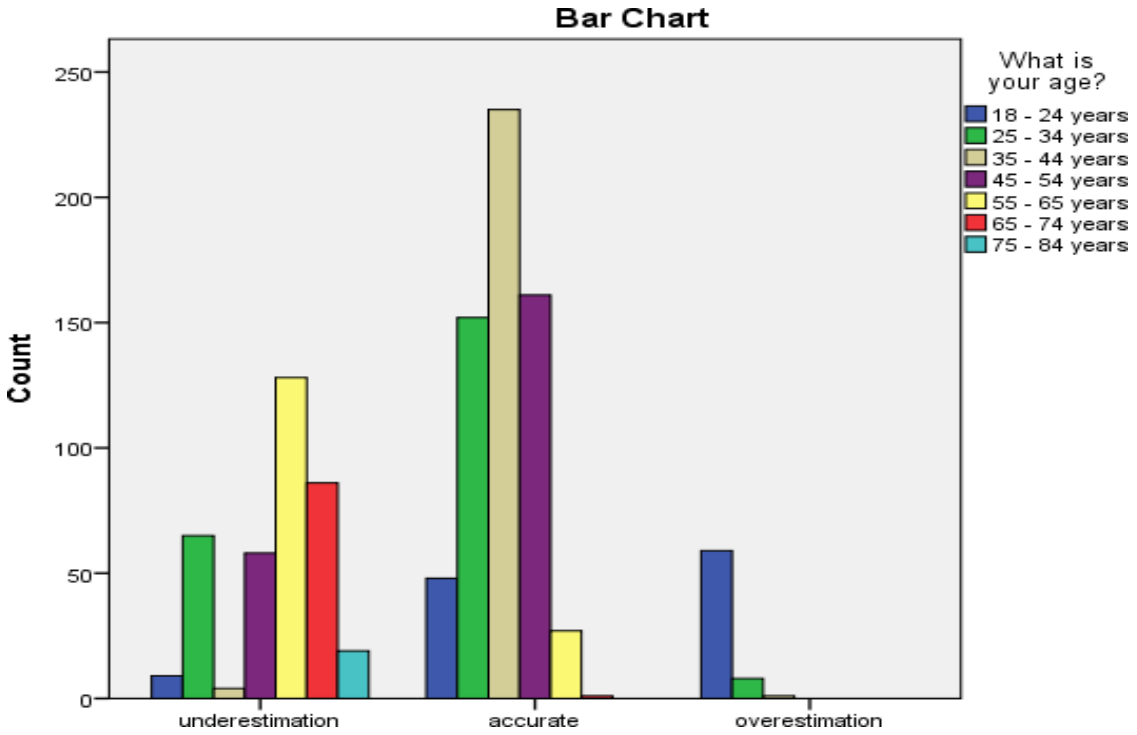
		Weight perceptions	What is your age?
Weight perceptions	Pearson Correlation	1	-.619-**
	Sig. (2-tailed)		.000
	N	1061	1061
What is your age?	Pearson Correlation	-.619-**	1
	Sig. (2-tailed)	.000	
	N	1061	1061

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3.8 Weight perceptions * What is your age? Cross tabulation

	What is your age?							
Weight perceptions	18 - 24 Years	25-34 years	35-44 years	45-54 years	55-65 years	65-74 years	75-84 years	Total
Underestimation	9	65	58	58	128	86	19	369
Accurate	48	152	161	161	27	1	0	624
Overestimation	59	8	0	0	0	0	0	68
Total	116	225	219	219	155	87	19	1061

Figure 3.5 Weight Perceptions by Age Groups



The regression analysis results in Tables (3.9 ,3.10, 3.11,3.12) show a negative correlation between dependent variable weight misperceptions (treated as nominal variable (underestimation=1, accurate=2, overestimation = 3) and independent variable (age). Which means as the age increases, the weight perceptions decreases and thus age was a significant and negative predictor of weight underestimation (F=656.308, Beta= -0.234, Adjusted R Square= 0.382).

Table 3.9 Variables Entered/Removed [a]

Model	Variables Entered	Variables Removed	Method
1	What is your age?[b]	.	Enter

a. Dependent Variable: Weight misperceptions
b. All requested Variables entered

Table 3.10 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.619[a]	.383	.382	.453

a. Predictors: (Constant), What is your age?

Table 3.11 ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	134.532	1	134.532	656.308	.000[b]
	Residual	217.076	1059	.205		
	Total	351.608	1060			

a. Dependent Variable: verbal weight misperceptions

b. Predictors: (Constant), What is your age?

Tables 3.12 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	2.742	.042		64.684	.000
	What is your age?	-.234-	.009	-.619-	-25.619-	.000

Educational level

When using the Pearson Correlation analysis, a negative significant correlation between the participants' educational level and weight perceptions status was observed (Table 3.13). Descriptive data from (Table 3.14), quantitatively analyses the relationship between different educational levels and weight perceptions and shows that lower educational levels e.g. 'A level or equivalent'', ''Undergraduate degree or equivalent (e.g., BSc, BA, etc.)'', were associated with the underestimation of weight status. Figure 3.6 compares weight perceptions between different educational levels.

Table 3.13 Pearson correlation between educational level and weight perceptions

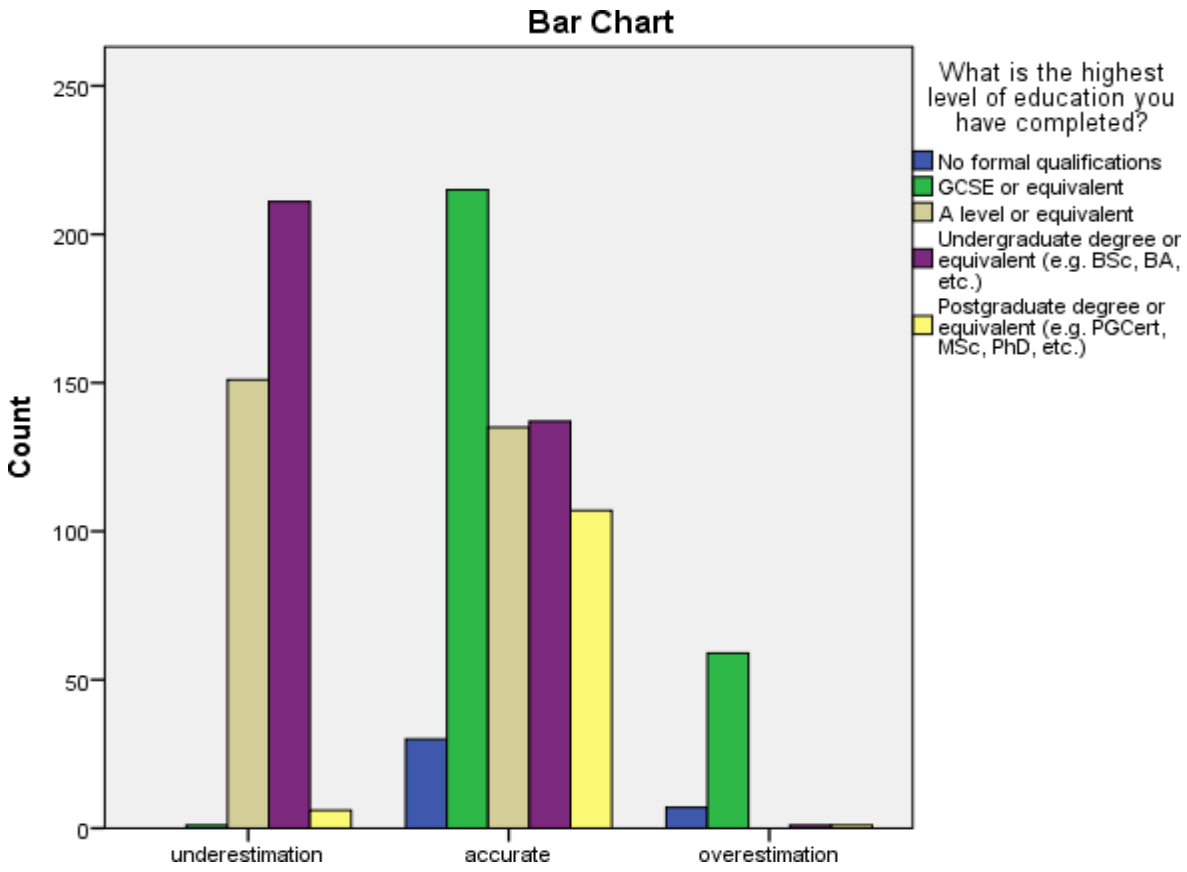
		Weight perceptions	What is the highest level of education you have completed?
Weight perceptions	Pearson Correlation	1	-.353-**
	Sig. (2-tailed)		.000
	N	1061	1061
What is the highest level of education you have completed?	Pearson Correlation	-.353-**	1
	Sig. (2-tailed)	.000	
	N	1061	1061

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3.14 Weight perceptions * What is the highest level of education you have completed?Cross tabulation

Weight perceptions	What is the highest level of education you have completed?				
	No formal qualifications	GCSE or equivalent	A level or equivalent	Undergraduate degree or equivalent (e.g . BSc, BA, etc.)	Postgraduate degree or equivalent (e.g . PGCert, MSc, PhD, etc.)
Underestimation	0	1	151	211	6
Accurate	30	215	135	137	107
Overestimation	7	59	0	1	1
Total	37	275	286	349	114

Figure3.6 Weight perceptions by educational levels



The regression analysis results in Tables (3.15 ,3.16, 3.17,3.18) shows a negative correlation between dependent variable weight misperceptions (treated as nominal variable (underestimation=1, accurate=2, overestimation = 3) and independent variable (educational levels). This means that as the educational level increase, the weight perceptions decreases and thus educational level was a significant and negative predictor of weight underestimation (F=150.8, Beta= -0.193, Adjusted R Square= 0.125).

Table 3.15 Variables Entered/Removed [a]

Model	Variables Entered	Variables Removed	Method
1	What is the highest level of education that you have completed?[b]	.	Enter

a. Dependent Variable: Weight misperceptions
b. All requested Variables entered

Table 3.16 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.353[a]	.125	.124	.539

a. Predictors: (Constant), What is the highest level of education you have completed?

Table 3.17 ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	34.828	1	34.828	150.802	.000 [b]
	Residual	307.780	1059	.291		
	Total	351.608	1060			

a. Dependent Variable: Weight misperceptions

b. Predictors: (Constant), What is the highest level of education you have completed?

Tables 3.18 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	2.336	.053		43.979	000
	What is your age?	-.193-	.016	-.353-	-12.280-	000

Bodyweight Norms

Underestimation of weight status and exposure to obesity

In order to examine whether adults who were exposed to heavier bodies in their everyday life were more likely to underestimate their weight status we first examined the relationship between exposure to obesity and verbal or visual weight perceptions. Using a Pearson

correlation analysis in the Table 3.19, it was found that there was a significant correlation $p \leq 0.01$ ($r=0.546$) between exposure to obesity and verbal weight perceptions. Similarly, there was a significant correlation $p \leq 0.01$ ($r=0.278$) between exposure to obesity and visual weight perceptions.

Table 3.19 Pearson correlation between exposure to obesity and verbal perceptions, visual perceptions

	Exposure to obesity	Verbal weight perceptions	Visual weight perceptions
Exposure to obesity		.546**	.278**
Verbal weight perceptions	.546**		.516**
Visual weight perceptions	.278**	.516**	

**. Correlation is significant at the 0.01 level (2-tailed). N=981

In order to explore the association between exposure to obesity and verbal and visual body weight perception groups (underestimation, accurate and overestimate), a one-way ANOVA test was used to determine whether there are any statistically significant differences between the means of each group (Table 3.20). For verbal weight perceptions, Table 3.20 shows statistical evidence that the associated population means are significantly different at the three conditions (underestimation, accurate and overestimate) [$F = 208.309$] $p<.001$. In order to detect the direction of differences, the *post hoc* test Scheffe was used as shown in (Table 3.21).

Table 3.20 one -way ANOVA to analyse the difference between the means groups.

	Sum of squares	df	Mean square	F	Sig.
Between Groups	327.150	2	163.575	208.309	.000
Within Groups	767.977	978	.785		
Total	1095.127	980			

Table 3.21 Results of the Scheffe test to determine whether individual means differs from another group of means.

Verbal misperceptions	N	Mean of Obesity exposure	Verbal misperceptions	Mean differences	Std. Error
Accurate	582	0.948	Overestimation Underestimation	-.73576-* -1.20667-*	.14837 .05937
Overestimation	38	1.684	Accurate underestimation	.73576* -.47091-*	.14837 .15113
Underestimation	316	2.155	Accurate overestimation	1.20667* .47091*	.05937 .15113

*The mean difference is significant at the 0.05 level.

As shown in Table 3.21 using the Scheffé *post hoc* test indicated that the exposure to obesity in everyday life was significantly higher in the group of people who underestimate their weight status (M=2.155) than in the other two groups of verbal weight perceptions (accurate M=0.948, overestimation=1.684).

Similar to verbal weight perceptions, the following Table 3.22 show that there is a significance difference [F =50.592] p<.001 in the level of obesity exposure between visual weight perceptions groups (underestimation, accurate and overestimation). In order to detect the direction of differences we used the Scheffe *post hoc* test. It can be seen from Table 3.23 using the Scheffé *post hoc* test indicated that the exposure to obesity in everyday life was significantly higher in the group of people who underestimate their weight status (M=2.054) than in the other two groups of visual weight perceptions (accurate M=1.251, overestimation=1.272).

Table 3.22 One -way ANOVA to analyse the difference between the mean groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	102.680	2	51.340	50.592	.000
Within Groups	992.448	978	1.015		
Total	1095.127	980			

Table 3.23 Results of the Scheffe test to determine whether individual means differ from another group of means

Visual misperceptions	N	Mean of obesity exposure	Visual misperceptions	Mean difference (I-J)	Std.Error
Accurate	582	1.251	Overestimation underestimation	-.02112- -.80258-*	.09064 .08139
Overestimate	38	1.272	Accurate Underestimation	.02112 -.78146-*	.09064 .10765
Underestimate	361	2.054	Accurate Overestimation	.80258* .78146*	.08139 .10765

*. The mean differences is significant at the 0.05

Perceptions of average body shape

The participants were asked "Which Figure best describes an average body shape/size for men/women your age?" using the pictorial Body-Size Guide (Harris *et al*. 2008). Using a Pearson correlation analysis in the Table 3.24, it was found that there was a significant correlation $p \leq 0.01$ ($r=0.561$) between exposure to obesity and verbal weight perceptions. Similarly, there was a significant correlation $p \leq 0.01$ ($r=0.354$) between exposure to obesity and visual weight perceptions.

Table 3.24 Pearson correlation between perceptions of an average body shape and verbal perceptions, visual perceptions

	Perceptions of an average body shape	Verbal Perceptions	Visual Perceptions
Perceptions of an average body shape		.561**	.345**
Verbal Perceptions	.516**		.516**
Visual Perceptions	.345**	.516**	

**. Correlation is significant at the 0.01 level (2-tailed). N=981

In order to explore the association between exposure to obesity and verbal and visual body weight perception groups (underestimation, accurate and overestimate), a one-way ANOVA test was used to determine whether there are any statistically significant differences between the means of each group (Table 3.25). For verbal weight perceptions, Table 3.25 shows statistical evidence that the associated population means are significantly different at the three conditions (underestimation, accurate and overestimate) [F =234.423] $p < .001$. In order to detect the direction of differences, the *post hoc* test Scheffe was used as shown in (Table 3.26).

Table 3.25 One -way ANOVA to analyse the difference between the mean groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	829.044	2	414.522	234.423	.000
Within Groups	1729.361	978	1.768		
Total	2558.406	980			

Table 3.26 Results of the Scheffe test to determine whether individual means differ from another group of means

(I) verbal perceptions	N	Mean of Average body shape	(J) verbal perceptions	Mean Difference (I-J)	Std. Error
Accurate	582	3.494	Overestimation underestimation	-.16305- -1.91513-*	.22265 .08909
Overestimate	38	3.657	Accurate Underestimation	.16305 -1.75208-*	.22265 .22679
Underestimate	361	5.410	Accurate Overestimation	*1.91513 1.75208*	.08909 .22679

*. The mean differences is significant at the 0.05

Using the Scheffé *post hoc* test, Table 3.26 indicated that the perceiving an overweight silhouette as an average body shape was significantly higher in the group of people who underestimate their weight status (M=5.410) than in the other two groups of visual weight perceptions (accurate M=3.494, overestimation=3.657).

Similar to verbal weight perceptions, the following Table 3.27 show that there is a significance difference [F=79.221] $p < .001$ in the level of obesity exposure between visual weight perceptions groups (underestimation, accurate and overestimation). In order to detect the direction of differences we used the Scheffe *post hoc* test. It can be seen from Table 3.28 using the Scheffé *post hoc* test indicated that the exposure to obesity in everyday life was significantly higher in the group of people who underestimate their weight status (M=5.384) than in the other two groups of visual weight perceptions (accurate M=3.878, overestimation=3.980).

Table 3.27 One -way ANOVA to analyse the difference between the mean groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	356.691	2	178.346	79.221	.000
Within Groups	2201.715	978	2.251		
Total	2558.406	980			

Table 3.28 Results of the Scheffe test to determine whether individual means differ from another group of means

(I) verbal perceptions	N	Mean of Average body shape	(J) verbal perceptions	Mean Difference (I-J)	Std. Error
Accurate	624	3.878	Overestimation underestimation	-.10231-- -1.50603-*	.13500 .12123
Overestimate	145	3.980	Accurate Underestimation	.10231- -1.40372-*	.13500 .16034
Underestimate	203	5.384	Accurate Overestimation	1.50603 1.40372*	.12123 .16034

*. The mean differences is significant at the 0.05

Weight stigma experience and internalised weight bias on weight perceptions

The result presented in the table below (Table 3.29) illustrates a significant negative correlation between weight stigma experience, weight bias internalisation and weight perception.

Table 3.29 Pearson correlation between verbal perceptions, visual perceptions and weight stigma experiences, weight stigma internalisation

	Verbal perceptions	Visual perceptions.	weight stigma experience	weight bias internalisation
Verbal perceptions		.516**	-.505-**	-.228-**
Visual perceptions.	.516**		-.461-**	-.289-**
weight stigma experience	-.505-**	-.461-**		
weight bias internalisation	-.228-**	-.289-**	.334**	

**. Correlation is significant at the 0.01 level (2-tailed). N=981

Table 3.30 One-way ANOVA to explore the differences between verbal perception(underestimation, accurate and overestimate) in weight stigma experiences and weight stigmainternalisation

		Sum of Squares	df	Mean Square	F	Sig.
Weight-stigma experience	Between Groups	21622.451	2	10811.225	170.413	.000
	Within Groups	62045.710	978	63.441		
	Total	83668.161	980			
Weight-stigma internalization	Between Groups	8060.397	2	4030.199	4030.199	.000
	Within Groups	125470.851	978	128.293		
	Total	133531.248	980			

A one-way ANOVA test was used to determine whether there are any statistically significant differences between the means of each group. For verbal weight perceptions, Table 3.30 shows statistical evidence that the associated population means of weight stigma experience is significantly different at the three conditions (underestimation, accurate and overestimate)[F =170.413] $p < .001$. Similarly, another statistical evidence that the associated population means of weight bias internalisation is significantly different at the three conditions (underestimation, accurate and overestimate) [F =4030.199] $p < .001$ (Table 3.30). To detect the direction of differences, the *post hoc* test Scheffe was used as shown in (Table 3.31).

Table 3.31 Results of the Scheffe test to determine whether individual means differ from another group of means

Dependent Variable	Mean	(I)verbal perceptions	(J) verbal perceptions	Mean Difference (I-J)	Std. Error
weight stigma experience	24.47	Accurate	Overestimation Underestimation	7.71330* 9.82869*	1.35840 .53361
	16.76	Overestimation	Accurate Underestimation	-7.71330-* 2.11539	1.35840 1.33361
	14.64	Underestimation	Accurate Overestimation	-9.82869-* -2.11539-	.53361 1.33361
weight stigma internalisation	52.19	Accurate	Overestimation Underestimation	8.32825* 5.68980*	1.93171 .75883
	43.86	Overestimation	Accurate Underestimation	-8.32825-* -2.63845-	1.93171 1.89646
	46.50	Underestimation	Accurate Overestimation	-5.68980-* 2.63845	.75883 1.89646

As shown in Table 3.31 *post hoc* analyses using the Scheffé post hoc test indicated that the weight stigma experience was significantly higher in the group of people who identified their weight status accurately (M=24.47) than in the other two groups (Underestimation M=14.64, overestimation=16.76). Similarly, *post hoc* analyses using the Scheffé post hoc test indicated that the weight bias internalisation was significantly higher in the group of people who identified their weight status accurately (M=52.19) than in the other two groups (Underestimation M=46.50, overestimation=43.86).

Similar to verbal weight perceptions, a one-way ANOVA test was used to determine whether there are any statistically significant differences between the means of each group. For visual weight perceptions, Table 3.32 shows statistical evidence that the associated population means of weight stigma experience is significantly different at the three conditions (underestimation, accurate and overestimate) [F =164.355] $p < .001$. Similarly, another

statistical evidence that the associated population means of weight bias internalisation is significantly different at the three conditions (underestimation, accurate and overestimate) [F =61.525] p < .001. In order to detect the direction of differences, the *post hoc* test Scheffe was used as shown in (Table 3.33).

Table 3.32 one - way ANOVA test to explore the differences between visual misperception (underestimation, accurate and overestimation) in weight stigma experiences and weight stigma internalisation

		Sum of Squares	df	Mean square	F	Sig.
weight stigma experience	Between Groups	21047.220	2	10523.610	164.355	.000
	Within Groups	62620.941	978	64.030		
	Total	83668.161	980			
weight bias internalisation	Between Groups	14923.065	2	7461.533	61.525	.000
	Within Groups	118608.183	978	121.276		
	Total	133531.248	980			

As shown in Table 3.33 below, *post hoc* analyses using the Scheffé post hoc test indicated that the weight stigma experience was significantly higher in the group of people who identified their weight status accurately (M=27.4) than in the other two groups (Underestimation M=15.85, overestimation=16.48). Similarly, *post hoc* analyses using the Scheffé post hoc test indicated that the weight bias internalisation was significantly higher in the group of people who identified their weight status accurately (M=56.11) than in the other two groups (Underestimation M=45.86, overestimation=46.67).

Table 3.33 Results of the Scheffe test to determine whether individual means differ from another group of means

Dependent Variable	Mean	(I)visual misperceptions	(J) visual misperceptions	Mean Difference (I-J)	Std. Error
weight stigma experience	27.4	Accurate	Overestimation Underestimation	10.91693-* 11.54497*	.85510 .64655
	16.48	Overestimation	Accurate Underestimation	-10.91693-* .62804	.85510 .71999
	15.85	Underestimation	Accurate Overestimation	-11.54497-* -.62804-	.64655 .71999
weight bias internalisation	56.11	Accurate	Overestimation Underestimation	-10.24966-* 9.44183*	1.17683 .88982
	45.86	Overestimation	Accurate Underestimation	-10.24966-* -.80784-	1.17683 .99089
	46.67	Underestimation	Accurate Overestimation	-9.44183-* .80784	.88982 .99089

*The mean difference is significant at the 0.05 level.

Negative emotions associated with obesity diagnosis (Fear of fat)

The study examined whether individuals who have a high level of fear of fat are more likely to underestimate their weight status. A positive correlation can be seen from (Table 3.34) between verbal misperceptions, visual misperceptions and fear of fat.

Table 3.34 Pearson correlation between verbal misperceptions, visual perceptions and fear of fat

	Verbal perceptions	Visual perceptions	Fear of fat
Verbal perceptions		0.516**	0.361**
Visual perceptions			0.328**
Fear of fat			

**. Correlation is significant at the 0.01 level (2-tailed). N=981

The results in Table 3.34 show that the variables fear of fat and verbal perceptions were significantly correlated r=0.361, p ≤ 0.01. Similarly, fear of fat and visual perceptions were significantly correlated r=0.328, p < .001. To explore the association between fear of fat and verbal and visual body weight perception (underestimation, accurate and overestimate), a one-way ANOVA test was used to determine whether there were any statistically significant differences between the means of each group(Table 3.35).

Table 3.35 One-way ANOVA test to explore the differences between verbal perception (underestimation, accurate and overestimate) and fear of fat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4114.236	2	2057.118	78.504	.000
Within Groups	25627.515	978	26.204		
Total	29741.751	980			

The results in Table 3.35 indicated that statistical evidence that the associated population means of fear of fat is significantly different at the three conditions of verbal weight perceptions (underestimation, accurate and overestimate) [F =78.504] p < .001. In order to detect the direction of differences the Scheffe *post hoc* test was used as follows.

Table 3.36 Results of the Scheffe test to determine whether individual means differs from another group of means

(I) verbal perceptions	Mean	(J) verbal perceptions	Mean Difference (I-J)	Std. Error
Accurate	24.54	overestimation	.51662	.87302
		underestimate	-4.11514-*	.34295
Overestimation	24.02	accurate	-.51662-	.87302
		underestimate	-4.63176-*	.85709
Underestimation	28.65	accurate	4.11514*	.34295
		overestimation	4.63176*	.85709

*The mean difference is significant at the 0.05 level.

As shown in Table 3.36 *post hoc* analyses using the Scheffé post hoc test indicated that the fear of fat was significantly higher in the group of people who underestimate their weight status (M=28.65) than in the other two groups (accurate M=24.54, overestimation=24.02). Similar to verbal misperceptions, the following Table 3.37 indicated that statistical evidencethat the associated population means of fear of fat is significantly different at the threeconditions of visual weight perceptions (underestimation, accurate and overestimate)[F=59.557], p < .001. In order to detect the direction of differences the Scheffe *post hoc* testwas used as follows. Table 3.38 show that the fear of fat was significantly higher in the groupof people who underestimate their weight status (M=28.19) than in the other two groups(accurate M=23.64, overestimation M=26.37).

Table 3.37 One-way ANOVA test to explore the differences between visual perception (underestimation, accurate and overestimate) in fear of fat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3229.080	2	1614.540	59.557	.000
Within Groups	26512.672	978	27.109		
Total	29741.751	980			

Table 3.38 Results of the Scheffe test to determine whether individual means differs from another group of means

(I) visual perceptions	Mean	(J) visual perceptions	Mean Difference (I-J)	Std. Error
Accurate	23.64	Overestimation Underestimate	-2.72481-* -4.54538-*	.55639 .42070
Overestimation	26.37	Accurate Underestimate	2.72481* -1.82058-*	.55639 .46848
Underestimate	28.19	Accurate Overestimation	4.54538* 1.82058*	.42070 .46848

*The mean difference is significant at the 0.05 level.

3.5 Discussion

It has been suggested that a large proportion of individuals with overweight and obesity do underestimate their weight status (Yaemsiri *et al*., 2011). Underestimation of weight status was highly prevalent in the study population. It was detected that a considerable percentage of adults in the overweight and obese categories inaccurately classified their weight status with almost half of the participants with overweight and two thirds of the participants with obesity underestimating their weight status using the verbal scale. However, fewer participants with overweight or obesity underestimated their weight status using the visual scale (29% and 12% respectively). The findings are consistent with prior research (Yang *et al*., 2021; Wu *et al*., 2021) which suggests that visual scales, rather than verbal perceived weight scales, are appropriate and more accurate for self-assessment of body weight. It seems possible that these results are due to the stigma attached with terms such as overweight and obese in the verbal scale, thus, visual scales avoid the need for labelled response options (Chaimovitz *et al*., 2008).

Males were more likely to underestimate their weight status than females when using the verbal scale (35% and 26%). Both males and females were more likely to be accurate when using the visual scale (54% and 59%). This finding concurs with previous epidemiological work where males with overweight and obesity were significantly more likely to underestimate their own weight status than females (Robinson, 2017; Oldham and Robinson, 2018; Opie *et al.*, 2019). This gender inconsistency is also consistent with the literature across western cultures, which suggests that mass media exposure which presents unrealistic slim female bodies may encourage weight misperceptions and change how females perceive their own weight (Groesz *et al*., 2002; Winkler and Rhodes, 2005).

Presenting a very slender female body as the example of beauty and attractiveness may therefore result in slimmer body shapes and sizes looking more normal for women than men

(Wiseman *et al.*, 1992). The same media influence may be also applied on men by encouraging muscular bodies and the desire for a macho image in addition to the general view that overweight is actually desirable for men (Uchôa *et al.*, 2019). Further research should be undertaken to investigate if exposure to very slender female bodies or heavier bodies in the media could affect individuals' body size norms and perceptions of weight. This study confirms the results of previous work (Bhanji *et al.*, 2011; Kim *et al.*, 2008; Park *et al.*, 2019) which suggested that older participants were more likely to underestimate their overweight status than younger participants. The reason for this is not clear but it may relate to the idea of older people are less concerned about their body image than younger people, which may alter their perception of weight (Bhanji *et al.*, 2018). Furthermore, underestimation was particularly high among participants with low educational levels in the present study. This finding is consistent with that of Sánchez *et al.*, (2015) and Gao and Jiang (2010) which suggest that higher weight misperceptions were associated with lower educational levels, contrary to the findings of two studies which suggest the opposite (Nieto-Garcia *et al.*, 1990; Stewart,1982). Although these two studies were conducted 30 years ago, however this inconsistency requires further investigation.

In terms of anthropometric factors, when a participant's weight was in the 'overweight' category, the level of underestimation was higher than for those who were in healthy and obese categories. Unlike the findings of Gregory *et al.*, (2008) who found that participants with overweight correctly identified themselves as being overweight than other groups. However, this accurate weight perceptions were more likely to be from females with overweight than males and this can be due to a number of factors, including the influence of societal standards of beauty and the desire to conform to those standards. In addition, rising adiposity in the population may have contributed to the "normalisation" obesity, resulting in greater

acceptance of body fat and less acknowledgment of obesity (Johnson *et al*.,2008).

This study contributes to the existing literature on social norms and suggests that the underestimation of overweight and obesity in personal evaluation is more likely to happen among people who are frequently exposed to obesity in everyday life. In support of this, several cross-sectional studies have published similar results, indicating that, in areas with significant obesity prevalence, the likelihood of weight status underestimations by parents or adults' personal evaluation is increased. In Binkin and colleagues' US-based study, the researchers demonstrated that mothers in areas with high obesity prevalence were more likely to be incorrect in assessing their child's weight status (Binkin *et al*. 2013). Similarly, schoolchildren were less likely to self-identify correctly as overweight or obese if a significant proportion of their peers were obese and, more generally, the slimness of an adolescent's social network was inversely correlated with an individual's ability to classify their weight status accurately (Maximova *et al*., 2008). When interpreted from the perspective of the visual normalisation theory, the findings indicate that, if obesity prevalence increases in a region, visual body size norms shift in individuals who are exposed to these larger body sizes. As a result, the perception that obesity is "normal" develops in line with these shifting visual body size norms, creating a situation in which obesity and overweight become under-detected (Johnson *et al*., 2008; Robinson, 2017). Environments in which obesity is appearing more 'normal' may help to encourage the underestimation of excess weight within self and others (Robinson, 2017). Festinger, (1954) and Wedell *et al*., (2005) suggest that people are making social comparisons when evaluating their own behaviour or appearance. Thus, current findings suggest that the participant who selected an overweight silhouette as an average body shape were more likely to underestimate their overweight status. In other words, personal perceptions of own body weight are influenced by how ''normal'' an individual believes his /her weight is in comparison

to others. This ‘norm comparison’ process could be the reasons behind this high prevalence of underestimation of overweight status as in many countries the perceptions of an average body shape have changed (Robinson, Kersbergen, 2017).

Adults with overweight and obesity experience weight stigma in both clinical and non-clinical settings (Puhl *et al*., 2010). Previous studies indicate that weight stigma experience may cause individuals to indulge in unhealthy eating and discourage exercise, both behaviours may encourage weight gain (Tomiyama *et al*., 2018). In the context of weight perceptions, prevalent weight stigma is more likely to make individuals get identified as being overweight or obese an undesirable experience that could elicit a negative emotional response (Oldham and Robinson, 2018). The current study has explored the association between weight stigma experience and weight bias internalisation and weight perceptions. Previous studies have not tested this association directly. In this study, it has been found that individuals who have a high level of weight stigma experience and weight bias internalisation were more likely to accurately perceive their weight status. This is an important point to consider in the context of weight related communication. Previous literature has suggested that participants who accurately perceived their weight as "overweight" reported more weight stigma concerns than participants who underestimated their weight and perceived their weight as "about right" (Sonneville *et al*., 2016).

It is well documented that obesity is a highly stigmatized condition, and terms such as “obesity” and “fat” are considered undesirable (Puhl *et al*., 2011) and by the adults themselves. In the context of perceptions of weight status, we propose that a fear of obesity diagnosis or in other words, the negative emotions associated with obesity diagnosis may act as a factor that impacts estimations of weight status. The results of this study suggest that people who have a high level of fear of obesity diagnosis were more likely to underestimate their weight status.

This result may be explained by the fact that an individual who is labelled as “overweight” or “obese” is exposed to a significant level of stigmatisation. For this reason, any individual who genuinely considers themselves to be overweight or obese is likely to be aware that, due to their weight status, they are members of a stigmatised social group (Puhl *et al*., 2010). This is a relevant point to note because, when an individual identifies with a stigmatised social group, this is likely to elevate their stress levels and diminish their sense of self-worth. Hence, there is a self-protection incentive among individuals, even if they suffer from overweight or obesity, to avoid personally identifying themselves in this way, thereby stabilises their psychological well-being. Empirical data supports this notion, including the findings published in a range of cross-sectional studies involving adolescents and adults (Thurston *et al*., 2016; Al Mamun *et al*., 2007). For example, one study by Roberts *et al*., (2013) seemed to observe that an individual’s accurate self-identification as overweight, as compared to the inaccurate self-identification of body weight status, was associated with a set of negative outcomes in terms of psychological health (e.g., quality of life and risk of depression).

Finally, this work has several implications for weight related communication and obesity treatment. Given that caregivers and healthcare professionals could be key factors for healthier behavioural change in individuals under their care, previous studies suggest that misperceiving overweight and obesity in others could be a barrier for engaging in any weight loss intervention. A study by Tschamler *et al*., (2010) suggests that caregivers who underestimate their childs’ overweight status were more likely to be unconcerned about their child's body weight and are less likely to encourage their child to engage in a weight loss intervention (Vuorela *et al*., 2010; Rhee *et al*., 2005). In the same vein, discussions about weight loss intervention are less likely to be established if healthcare professionals underestimated thepatients' weight (Robinson *et al*., 2014). The abovementioned studies are supporting the

need for an accurate identification of overweight and obesity by educating parents and healthcare professionals to recognize body weight norms that represent a healthier weight (Oldham and Robinson, 2018).

However, there is also evidence which suggests the opposite (Al Mamun *et al*., 2007). Underestimation of overweight and obesity may not be a barrier for weight loss intervention, because correct identification of weight status has been found to diminish psychological well-being, increase the rate of disordered eating and lead to undesirable mental health conditions such as depression (Al Mamun *et al*., 2007). Furthermore, self-identification as overweight was associated with an increased tendency to overeat and consequently lead to weight gain in both adults (Robinson *et al*., 2015; Romano *et al*., 2018) and children (Robinson and Sutin 2016). These results may be justified by the fact that obesity is a highly stigmatized condition. For some individuals who believe that they are a member of the stigmatised social group of overweight and obese people, the motivation to lose weight and, in this way, to exit the stigmatised group may result in counterproductive, extreme efforts. One key to this would be to ensure that weight related communication and public health messages are delivered to patients in a clear, sensitive and non-judgmental or stigmatizing way and to ensure that in any future weight loss interventions, stigma reduction is prioritised. Furthermore, future studies are needed to explore different techniques for minimising the possibly negative impacts that self-identified overweight estimations can have on weight-related behaviours, body acceptance and weight gain.

To sum up, weight misperception among UK adults is a significant issue with far-reaching implications for health and healthcare. The relationship between weight misperception and health outcomes is complex, and further research is needed to fully understand the extent and implications of weight misperception. Healthcare professionals and policy-makers should

consider the issue of weight misperception when designing and implementing interventions to address obesity and promote weight loss, and take a holistic approach that addresses not only physical health but also the psychological and socio-economic impact of weight misperception.

3.6 Limitations

The most important limitation lies in the fact that the anthropometric data were self-reported and therefore the results may be influenced by social desirability bias, as individuals may provide imprecise height and weights in an effort to meet social standards or believed to be socially accepted. However, a previous study has proved the validity of online self-report of height and weight by young adults (Paul *et al.,* 2015). The generalisability of these results is subject to certain limitations. For instance, the results of this study were from the UK and cannot be generalised to other contexts. Another limitation of this study is the use of quantitative approach which did not allow for depth understanding of reasons for human behaviour, experiences, attitudes and the causality of the relation between variables cannot be confirmed. Due to the majority of respondents being white, we were not able to test for differences across ethnic groups. Previous studies suggest that ethnicity has an effect of body weight norms and identification (Dorsey *et al*., 2010), therefore replicating this study with multi ethnicity samples would help to establish a greater degree of accuracy on this matter. Furthermore, web-based testing, due to the perceived greater anonymity, has been found to increase the accuracy of socially desirable reactions compared to pen-and-pencil surveys when looking for a divulgence of sensitive issues (Opie *et al*., 2019). Notwithstanding these limitations, there are strengths of the empirical work conducted throughout this study. The main strength of the current study is use of large sample sizes, with a relatively even split between males and females, which allowed for statistical significance to be tested. To the author knowledge this is the first study which examined the relationship between fear of obesity diagnosis and underestimation of overweight status. In addition, unlike most of the previous studies in this area,

this study used validated verbal and visual scales to make sure psychological factors were accurately measured. Finally, unexplored factors linked to weight misperception by adults were determined in this paper.

3.7 Conclusion

This study has proved that the underestimation of weight status was very common among people with higher weight. Underestimation of self-perceived weight was associated with age -gender- education and current BMI. People who had high levels of the fear of obesity diagnosis were more likely to underestimate their weight status. In addition, the participants who had high levels of weight stigma experience, internalised weight bias were more likely to be accurate about their own weight status. Further research is required to better understand the factors affecting these misperceptions if we want to create effective strategies to improve communication with the target population in order to prevent and treat obesity in the future. In additions, the effectiveness of non-stigmatising weight related communication and weight control behaviours would be a fruitful area for further work and is needed to support the implications of this study's findings.

Chapter 4: Underestimating the Weight Status of Children: An Investigation into Factors Associated in Adult's Evaluations of Children's Bodyweight

4.1 Chapter introduction

Childhood overweight and obesity research continues to back up the notion that this health problem is widespread in both the developed and developing worlds. Parents can play an important role in promoting healthier behaviours and dealing with numerous environmental obesogenic factors. In both the prevention and treatment of childhood overweight or obesity, the parents' active participation in intervention programs is an important component (Van Der Kruk *et al.*, 2013). As a first step in preventing childhood obesity and in order to encourage parents to effectively change food and physical activity behaviours, they must first recognise and accurately perceive their child's overweight status. As outlined in study 1 and most of the recent research in this area, parents repeatedly underestimate the presence of childhood overweight (Doolen *et al.*, 2009; Towns and D'Auria, 2009; Rietmeijer-Mentink *et al.*, 2013; Alshahrani *et al.*, 2021). Investigating the associated factors with this underestimation may therefore be a highly important factor for consideration in devising strategies for efforts to treat and prevent childhood obesity. This may have the potential to improve both the communication within the therapeutic triad and the recognition of overweight.

This chapter will build on the findings of the previous chapters and integrate the associative factors identified in the literature to-date in order to understand the relative contribution of each factor.

4.2 Introduction

Childhood obesity is a significant and far-reaching public health challenge, currently affecting 9.9% of children in Reception and 20.1% of children in Year 6 in the United Kingdom (National Child Weight Measurement Program NCMP, 2020). Obesity is associated with a number of long

and short term physical and psychosocial health outcomes including hypertension, type 2 diabetes, sleep apnoea, anxiety, depression, and low self-esteem (Pulgaron, 2013). Hence, the prevention, detection, and handling of obesity during childhood is critical for effectively optimising quality of life and health.

Across countries, the absence of a public recognition of obesity and its adverse consequences represents major challenges to the provision of obesity prevention and management (Wolfenden *et al*., 2019). A strong evidence-base has been developed to demonstrate that, based upon visual information, people systematically underestimate overweight in others (Robinson, 2017). It is generally accepted that a significant barrier to intervention is that parents of children with overweight and/or obesity underestimate their children's weight status (Ruiter *et al*., 2020). A recent systematic review and meta-analysis (Alshahrani *et al*., 2021) demonstrated that parents and children consistently underestimated their children's overweight status and that although there was insufficient data to perform a sub-group meta-analysis, underestimation of overweight also applied to a significant number of healthcare professionals. Furthermore, underestimation was positively associated with a variety of factors: child age, gender, current BMI and parental weight status, education and ethnicity. Adams *et al*., (2005) and Robinson, (2017) note that the modification in the perception of what is a normal weight, alongside the patterns of larger body size, within the cultural perceptions on the matter, are additional aspects impacting and partially explicating consistent parental underestimation of the weight status of their children. Another possible factor found in the literature is that parents may be due to the lack of knowledge regarding what is the true definition of overweight, or refusal to acknowledge that their child is with overweight to avoid being judged as bad parents (Turner *et al*., 2012). Preferred body size has been identified as an additional predictive factor for mothers when evaluating their own child (Pasch *et al*., 2016).Yet

it is still unknown if these visual-norm explanations are also linked with parental underestimation of overweight. This will be explored in the current study.

Similarly, the research on adult personal evaluations of weight status demonstrates that large numbers of adults with overweight underestimate their own weight status and that, instead, they classify their weight status as healthy or 'about right' (Kuchler and Variyam, 2003; Yaemsiri *et al*., 2010; Johnson *et al*., 2014; Robinson and Oldham, 2016). Regardless of the weight measurement method (perceived or objective), this underestimation is consistent. These inaccuracies can be influenced by beliefs about perceptions of 'average' body sizes (Robinson and Kersbergen, 2017). Furthermore, there are factors associated with the underestimation of overweight status including an awareness of guidelines, race and ethnic-minority status, gender, and socioeconomic status (Robinson, 2017). The result of the previous chapter shows that individuals with overweight and obesity are more likely to underestimate their weight status if they have high levels of negative emotions related to obesity diagnosis. It is unclear if this also applies to parents who have high levels of negative emotions associated with a child being categorized as obese. Hence the importance of this study.

To date, the reasons for underestimation have been unclear. Underestimation of weight status in others may have a public health significance, especially for caregivers (Ruiter *et al*., 2017) as they are important factors in encouraging healthier behaviour in others. Sigmund *et al*., (2018) reported on parents' key roles in forming children's health behaviours. The American Heart Association also refers to parents as "agents of change" for their children (Faith *et al*., 2012). Both emphasise the defining role of parents for the success or failure of, or even participation in, weight management and/or lifestyle interventions for overweight and obesity. Previous studies have suggested that family-based interventions are the most effective approaches for preventing and treating obesity in children (Hoelscher *et al*., 2013). However, most of the

previous studies have relied on mothers' perceptions alone, this study intends to investigate this issue from a wider familial perception and includes both parents and grandparents in order to provide further insight into the factors associated with this underestimation. In addition, although most of the previous studies in this area have adopted quantitative research method to assess parental misperceptions (Chaimovitz *et al.,* 2008; Moschonis *et al.,* 2011; Rietmeijer-Mentink *et al.,* 2013), however, these studies suffer from methodological limitation, as these studies are cross-sectional, assessing a parent's perception at a single age group. As children grow and develop, a parent's judgement of their child's weight may change. In order to overcome the methodological limitations of the past studies in this area, the current study assessed parental perceptions for different age groups (5-6) years (7-10) years. It is hoped that this research will contribute to a deeper understanding of the associative factors identified in the literature to-date and that this can help in order to understand the relative contribution of each factor.

Aim:

To empirically investigate the relationship between sociodemographic, anthropometric, and psychological factors in adults' underestimation of the overweight and obese weight status of children.

4.3 Methodology

The methodology and research methods adopted and utilised in this paper will be comprehensively explicated in this section. The benefits and drawbacks of the research tools selected will be outlined as part of the research design section following the research approach selection being explicated. Subsequently, the capacity of such methods to meet the research objectives and goals of the paper will be explored. This section is followed by an examination

of the data analysis methods utilised alongside an exploration of the implemented sampling strategy and total sample strategy. Finally, the section reaches its conclusion by discussing the issues the research confronted as well as the limitations experienced in enacting the research methodology and any relevant ethical considerations.

4.3.1 Research approach, survey design, recruitment, and participants

The current study adopted an anonymous cross-sectional design and involved a self-reported online survey delivered by Jisc online surveys (JISC®) (https://www.onlinesurveys.ac.uk/). This tool is an online survey tool designed for academic research, education and public sector organisations (JISC, 2020). The questionnaire was piloted with four members to help to identify questions that did not make sense to participants, or problems with the questionnaire that might lead to biased answers. Responses were collated between 29 April 2020 - 27 May 2020. The sample was recruited from the following three online forums, Netmums www.netmums.com, Grandsnet https://www.gransnet.com/forums and Twitter which have appropriate gate-keeping measures in place. The use of such online platforms has some limitations such as sampling bias. However, the advantages of recruiting samples via online platforms far outweighed the limitations due to the inexpensive, simple, and efficient methodology that generates a National sample (Herbell and Zauszniewski, 2018). Cohen, (1980) defines quantitative research as the use of empirical statements and empirical methods within social research (Cohen, 1980). The purpose of using quantitively research methods in this paper is to examine phenomena or occurrences affecting people and provides answers to questions about the frequency of a phenomenon, or the magnitude to which the phenomenon affects the sample. The questionnaire (see Appendix D) was designed to capture parents and grandparent's perception of their own and their children's body weight in order to investigate the related factors associated with the potential underestimation. The participants were asked

to provide self- reported data on a range of sociodemographic, anthropometric, psychological, and healthcharacteristics of their own condition and their children's. The online survey used skip logic (e.g. gender) to personalise subsequent items, thereby reducing the survey length and time required to complete the survey. The questions were organised into four thematic blocks. The first collected data about the socio-demographics of the parents and the grandparents including gender, age, highest level of education attained, self-rated health and ethnicity. Thesecond focused on the personal perceptions of parents and the grandparents' own weight status, using verbal and visual scales. The same visual scale was used to assess parents and grandparents' own body weight norms and perceptions regarding average body shape and size. The questions included in the third block investigated parental perceptions of their children's weight status as well as their body weight norms and the preferences of their children's weight using verbal and visual scales. The fourth block of questions examined psychological factors (weight bias internalisation and fear of obesity diagnosis) associated with adult underestimation of their children or grandchildren's weight. Potential participants were aged 18 years or over and had to have a child or children or a grandchild or grandchildren aged between 5-10 years. The participants with multiple children or grandchildren within the age range were asked to select one child at each age group (5-6) years (7-10) years.

Anthropometric Data for Parents and Grandparents

Weight and height were self-reported in whichever metric the individual preferred. Questions like, "How much do you weigh? (in kg and stone/lbs), What is your height? (In cm and feet/inches)" were used. The BMI was subsequently calculated, and their BMI status was classified into categories using the adult weight classification based on the World Health Organisation (WHO, 2000) definitions for BMI. These were classified as follows, Underweight if their BMI was less than 18.5kg/m², healthy weight if their BMI was equal to 18.6-24.95kg/m²,

Overweight if their BMI was between 25-29.95kg/m² and obese if their BMI was over 30.5kg/m².

Perceived Weight Status

Perceived weight was measured by using verbal and visual instruments. In the verbal assessment, the participants were asked, "According to these widely used medical criteria, would you say that (at the moment) your weight can best be described as: Under-weight, Healthy weight, Over-weight, Obese''. Using the visual scale, the participants were asked, "Which Figure best describes your present body shape/size?" These silhouettes were developed by Harris *et al*., (2008) as a novel pictorial method for assessing perception of weight status and have been assessed for validity and test-retest reliability. Both study 2 and this study utilised these silhouettes to assess perception of weight status in individuals ~~both self~~ and others, with the aim of identifying body weight norms associated with the underestimation of weight status.

Figure 4.1 Silhouettes were developed by Harris *et al*. 2008 as a novel pictorial method for assessing perception of weight status.



Bodyweight Norms (adapted from Oldham and Robinson, 2016)

Perceptions of average body size

To measure perceptions of average body size the participants were asked "Which Figure best describes an average body shape/size for men/women your age?" using Harris *et al*.,'s pictorial Body-Size Guide (Harris *et al*., 2008).

Children's Demographic and Anthropometric Data Collection

Parents and grandparents reported their children or grandchildren's age, gender, weight and height data for their children or grandchildren. Body mass index (BMI) standardised for age and sex, relative to UK-WHO growth references for children and adolescents aged 2-18 years old, was used to define underweight being on the 2nd centile or below; healthy weight being between the 2nd and 91st centiles; overweight being on the 91st centile or above; and obese

being on the 98th centile or above. For the purpose of this study and related calculations, all the children were assumed to be at the midpoint of their age-year.

Parents and Grandparents' Perceptions of their Child/Grandchild's weight

Perceived weight was measured by using verbal and visual instruments. In the verbal assessment, the participants were asked the question, "Would you categorise any of your children/grandchildren who is currently aged 5-6 or 7-10 years, (if you have multiple children in these age-groups, please select one child for each age category), as 'overweight', 'obese', 'not overweight or obese'. In the visual scale, the parents and grandparents of the children aged from 5-6yrs were asked, "Which Figure best represents the body shape/size of the selected child aged 5-6yrs?" using the Warschburger Scale. These silhouettes were developed by Warschburger *et al*., (2012) as a novel pictorial method for assessing perception of weight status, each silhouette is based on standard anthropometric measures e.g. (the first two silhouettes represented underweight children being on the (3^{rd} and 10^{th} percentile), three sketches represented normal weight children (25^{th}, 50^{th} and 75^{th} percentile), and two represented an overweight or obese child (90^{th} and 97^{th} percentile) (Figure 4.2). This scale has been assessed for validity and test-retest reliability. Parents and grandparents of children aged from 7-10 years were asked "Which Figure best represents body shapes/sizes of the selected 7-10 age child?" using the Collins Scale (Collins, 1991). This scale contains seven silhouettes and is also based on anthropometric measures (1 underweight to 7 obese), age (7-10 years) and both genders (male, female). This scale has previously been assessed for validity and test-retest reliability for this age-group (Figure 4.3).

Figure 4.2 Warschburger Scale for Children Age from 5-6 Years

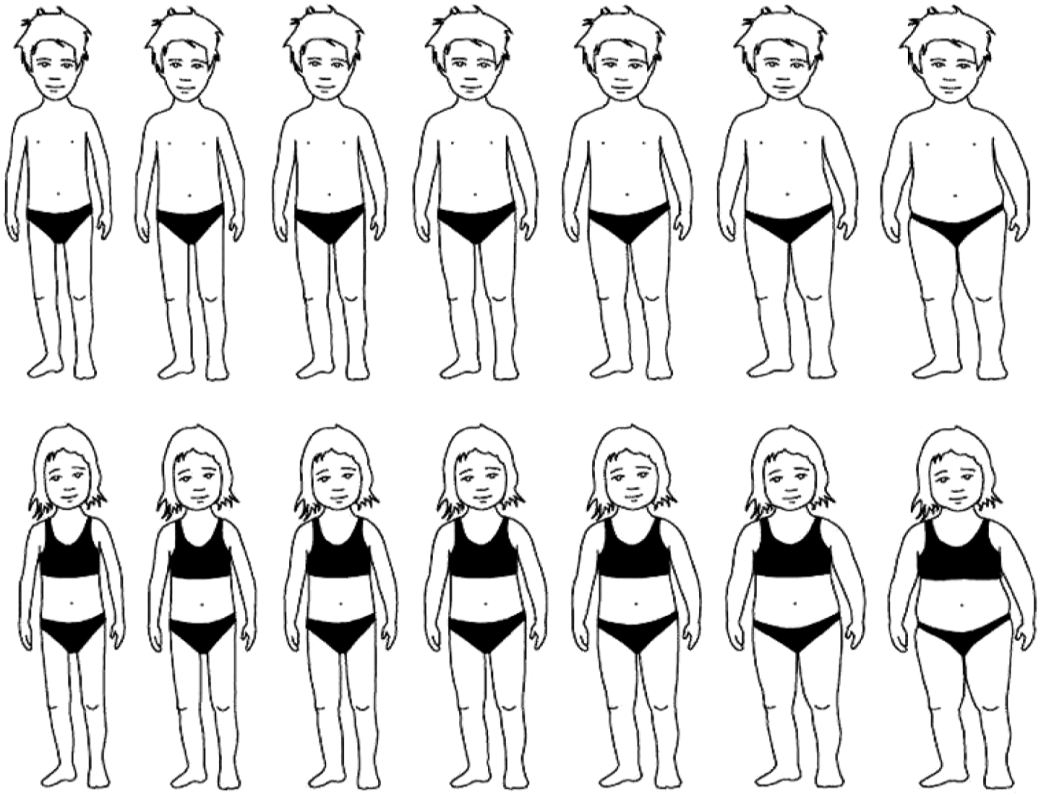
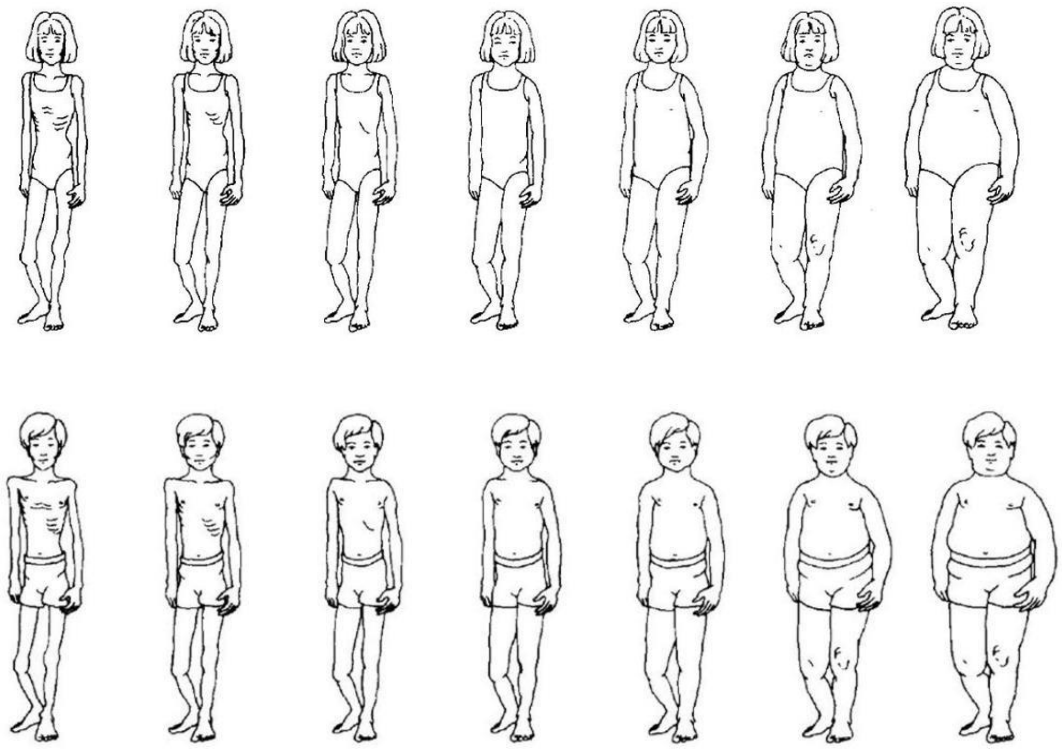


Figure 4.3 Collins 1991 for Children Aged from 7-10 Years



Adult's Body Weight Norms and their Preferences of Children's Weight

Exposure to Obesity

To test whether the tendency to underestimate a child's weight status may be explained by exposure to other children with heavier body weight, parents and grandparents of children aged from 5-6yrs were shown the seven photographs for both child's gender and were asked to select all those body shape/sizes that they would normally see in everyday life?" using the Warschburger Scale (Warschburger *et al*., 2012). For children aged 7-10 years, parents and grandparents were asked to select all those body shape or sizes that they would normally see in everyday life using the Collins Scale (Collins, 1991).

Average Body Size

To assess carers' perceptions of the average body size of children aged from 5-6 years, adult carers were asked, "Which Figure best describes an average body shape/size for children aged 5-6?" again using the Warschburger Scale (Warschburger *et al*., 2012). Caregivers of children aged from 7-10 years were asked "Which Figure best describes an average body shape/size for children aged 7-10?" using the Collins Scale (Collins, 1991).

Preferred Body Size

To assess parents/grandparents' perceptions of the preferred body size of children aged from 5-6- and 7-10-years caregivers were asked, "Which of the silhouettes do you prefer for a child aged 5-6 (Warschburger *et al*., 2012) and 7-10 (Collins, 1991)?

Adults' Internalised Weight Bias

Internalised weight bias was determined using the Weight Bias Internalisation Survey (WBIS-M) (Pearl and Puhl, 2014). The WBIS-M is a reliable and validated (Pearl and Puhl, 2014; Pearl and Puhl, 2018) version of the original WBIS developed by Durso and Latner (2008). The scale

measures the degree to which individuals apply weight-based stereotypes to themselves and base their self-evaluations on weight (Pearl and Puhl, 2014). The data obtained from these survey questions was recoded as per the authors' instructions and a mean score calculated. Possible scores range from 1-7 with higher scores indicative of greater internalised weight bias.

Negative Emotions Associated with a Child Being Categorized as Obese (Fear of Fat)

A Fear of Obesity scale was developed by the researchers from (Crandell, 1994; Goldfarb *et al*., 1985; Lillis and Hayes, 2008). This scale is adapted for use for children. The data was recoded as per the authors' instructions, and a mean score calculated. The possible scores range from 1-10 with higher scores indicative of a greater fear of children being identified as obese.

Data analysis

First, a calculation was made of each parent's/grandparent's and child's body mass index (BMI) based on weight and height as reported by the parents and grandparents for themselves and their children. Each parent and grandparent and child's BMI was then converted to a weight status and classified into one of three categories: underweight, healthy weight, overweight and obese, based on the UK growth charts for girls and boys. The parents and grandparents' BMI was also converted to weight status (WHO, 2000). A Microsoft EXCEL program was used to measure the agreement between caregivers' perceptions of their own and their children's weights and their weight based on the calculated BMI for both verbal and visual scales. All the statistical analyses were performed using the IBM SPSS Complex Samples Statistics version 20. The normality test was performed to assess the normal distribution of the variables using the Kolmogorov-Smirnov and Shapiro-Wilk test. Spearman's correlations tests were used to identify factors associated with parents and grandparents' underestimation of children's weight status.

4.3.2 Ethical Approval

This study has been approved by the School of Biosciences, The University of Nottingham (SBREC190129A). There were several types of ethical issues, which the researcher had to take into consideration for this project. The most important one was related to the informed consent of the participants. All the participants were informed in advance about the purpose of this project and gave their informed consent to participate. The participants were informed (Appendix C) that the information provided would be stored securely and treated confidentially in accordance with the University of Nottingham's GDPR policy (further details of which can be found at: https://www.nottingham.ac.uk/governance/documents/data-protection-policy-approved.pdf). Only researchers from the University of Nottingham will see the data and data will be stored electronically, adhering to the university's data protection guidelines. The participants were also informed that anonymity could not be guaranteed if the participants disclosed any illegal activities or if there is disclosure or evidence of significant harm, abuse, neglect or danger to themselves or others.

4.4 Results

Socio-demographic Characteristics of the Children and Adult Caregivers

The online survey was completed by 47 parents and grandparents. The demographic details of the sample are shown in Table 4.1. The sample was predominantly aged between 25-44 years (57%). Adult caregivers were mothers or grandmothers (n = 27, 57%) and fathers or grandfathers (n = 20, 43%). Almost half of the caregivers self-identified as White (n = 26, 55.3%). Around 50% of caregivers had an undergraduate degree or equivalent (n= 23, 48.9%). On average, the caregivers had BMIs of (26.5) kg/m² (SD= 4.30).

The children were split into two groups based on their age. From the total sample of the children was n= 31 (49%). The children were aged 5-6 years and n=32 (51%) aged from 7-10

years. ~~In~~ Among the children aged 5-6 years, almost half of the sample were girls and 58% were boys. Based on the calculated weight and height for this age group, 52% were categorised as healthy, 25% were categorised as overweight and 23% as obese. For children aged from 7-10, almost half of the children were girls and 50% were boys. Based on the calculated weight and height for this age group, 48% were categorised as healthy, 35% were categorised as overweight and 17% as obese.

Table 4.1 Summary of the Socio-demographic characteristics of the study population

Parental/ grandparent characteristics	N	%
Age		
25-44 Years	27	57.4%
45-74 Years	16	34.0%
75+ Years	4	8.5%
Total	47	100.0%
Gender	N	%
Male caregivers	20	42.6%
Female caregivers	27	57.4%
Ethnicity		
White British, Irish, Other White	26	55.3%
Black and Black British, Black Caribbean, Black African, Other Black	5	10.6%
Mixed (White and Black Caribbean, White and Black African, White and Asian, Other mixed	2	4.3%
Asian and Asian British, Indian, Pakistani, Bangladeshi, Gujarati, Tamil, Other Asian	9	19.1%
Other	5	10.6%
Total	47	100.0%
Education	N	%
No formal qualifications	1	2.1%
GCSE or equivalent	2	4.3%
A level or equivalent	4	8.5%
Undergraduate degree or equivalent	23	48.9%
Postgraduate degree or equivalent	17	36.2%
Total	47	100.0%
Age of child	N	%
5-6 years	31	49%
7-10 years	32	51%

Adult caregiver's weight status based on calculated BMI	N	%
Underweight	1	2.1%
Healthy	17	36.2%
Overweight	21	44.7%
Obese	8	17.0 %
Total	47	100.0%
Child's weight status based on calculated BMI	N	%
Child aged 5-6 years		
Healthy	16	52%
Overweight	8	25%
Obese	7	23%
Total	31	100%
Child aged 7-10 years	N	%
Healthy	16	48%
Overweight	11	35%
obese	5	17%
Total	32	100%

Parents and Grandparents' Perceptions of Their Own Weight Status

Verbal Perceptions and Visual Perceptions

Using the verbal scale, a total of n=16 (34%) of caregivers underestimated their own body weight. 61.7% (n-=29) were accurate while 4.3% (n=2) overestimated (see Table 4.2). The parents and grandparents were also asked to indicate which visual image best represented their current body weight. 29.8% (n=14) of the parents and grandparents underestimated their body weight. 57.4% (n=27) were accurate. 12.8% (n=6) overestimated (see Table 4.3).

Table 4.2 Verbal Weight perceptions of Parents and Grandparents of their Own Weight Status

Weight based on calculated BMI	Verbal weight perceptions N=47			
	Underestimation	Accurate	Overestimation	Total
Underweight	0	1	0	1
Healthy weight	0	15	2	17
Overweight	10	11	0	21
Obese	6	2	0	8
Total	16 (34%)	29 (61.7%)	2 (4.3%)	47 (100%)

Figure 4.4 Verbal Weight Perceptions of Parents and Grandparents of their Own Weight Status

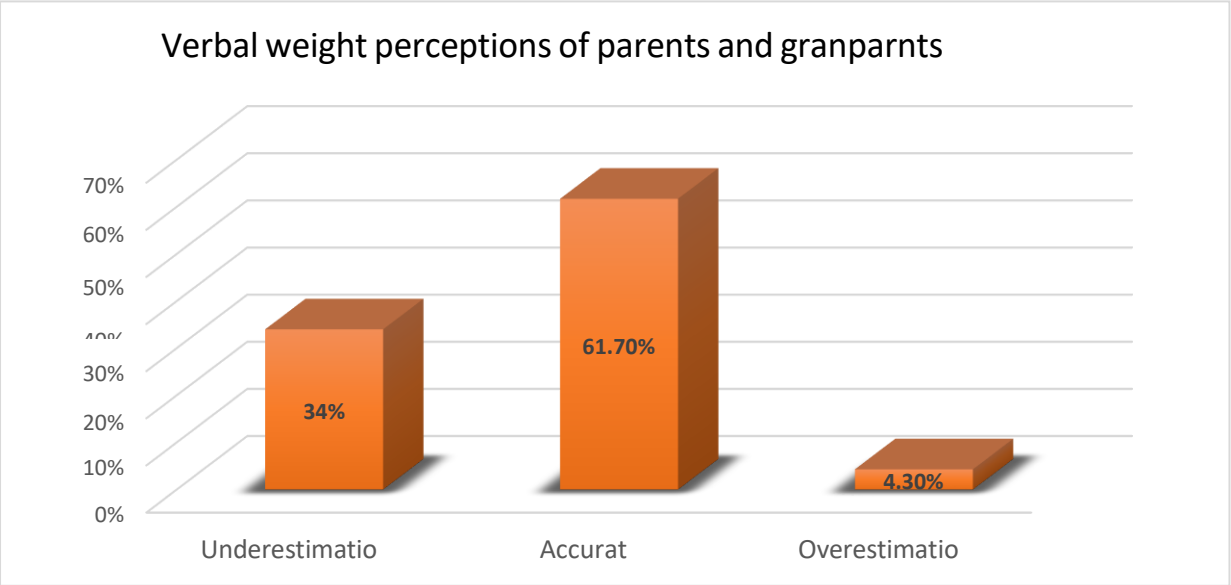
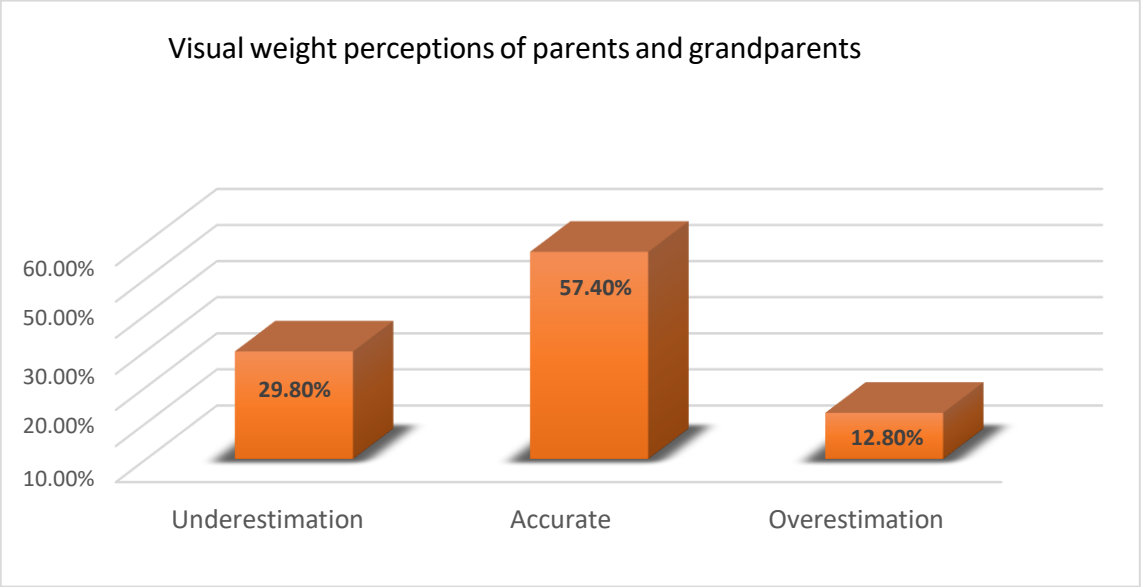


Table 4.3 Visual Weight perceptions of Parents and Grandparents of their Own Weight Status

Weight based on calculated BMI	Visual weight perceptions N=47			
	Underestimation	Accurate	Overestimation	Total
Underweight	0	1	0	1
Healthy weight	3	13	1	17
Overweight	8	8	5	21
Obese	3	5	0	8
Total	14 (29.8%)	27 (57.4%)	6 (12.8%)	47

Figure 4.5 Visual Weight Perceptions of Parents and Grandparents of their Own Weight Status



Adults' own Bodyweight Norms (adapted from Oldham and Robinson, 2016)

Average Body Shape and Size

The parents and grandparents were asked to indicate which body figure represented an average body shape. The majority (63%) of the respondents selected (C) which represents a healthy body shape, 27% of the participants selected (D) which represents an overweight body shape and 10.6% selected E which represents an obese body shape.

Parents and Grandparents' Perceptions of Their Children and Grandchildren's Body Weight

Verbal and Visual Misperceptions of Children's Weight Aged From 5-6 Years

In total 17 (55%) parents and grandparents of children aged from 5-6 years underestimated their children/grandchildren's bodyweight and 45% (n=15) were accurate using verbal assessment (Table 4.4). Using the visual scale, 71% (n=22) of parents and grandparents underestimated their children aged 5-6 years' body weight and 22 % (n=9) were accurate (Table 4.4).

Table 4.4 Verbal Misperceptions of Children's Weight Aged From 5-6 Years

	Verbal misperception		Visual misperception	
	N	%	N	%
Underestimation	17	55	22	71
Accurate	15	45	9	22
Overestimation	0	0	0	0
Total	32	100	31	100

Verbal and Visual Misperceptions of Children's Weight Aged From 7-10 Years

42% (n=13) of parents and grandparents verbally underestimated their children's body weight and 58% (n=18) were accurate (Table 4.5). 59% (n=19) of adult caregivers visually underestimated the children aged 7-10 years' body weight while 41% (n=13) were accurate. (Table 4.5).

Table 4.5 Verbal and Visual Misperceptions of Children's Weight Aged From 7-10 Years

	Verbal misperception		Visual misperception	
	N	%	N	%
Underestimation	13	42%	19	59%
Accurate	18	58%	13	41%
Overestimation	0	0	0	0
Total	31	100%	32	100%

Sociodemographic Factors Contributing to Adult Underestimation of Children's Weight Status

Child's Gender

To test the relationship between the child's age and verbal misperceptions, visual misperceptions, the Spearman correlation test was performed. The Spearman correlation revealed a significant correlation at $p \leq 0.01$ ($r=0.809$) between the child's gender and verbal perceptions and between the child's gender and visual perceptions $p \leq 0.01$ ($r=0.525$) (see

Table 4.6). To determine this correlation based on child's gender, a Mann Whitney test was performed (see Table 4.7).

Table 4.6 Spearman's Correlations Between Child Gender and Verbal, Visual perceptions.

		Child's Gender	Verbal misperceptions	Visual misperceptions
Spearman's rho	Child's Gender	1.000	.809**	.525**
	Verbal Misperceptions		1.000	.591**
	Visual Misperceptions			1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.7 Mann-Whitney Test to Compare the Differences Between Gender and Verbal and Visual perceptions

	Gender of child	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	z	Sig.
Verbal perceptions	Girl	33	44.14	1456.50	94.500	559.500	-6.371-	.000
	Boy	30	18.65	559.50				
	Total	63						
Visual perceptions	Girl	33	39.59	1306.50	244.500	709.500	-4.134-	.000
	Boy	30	23.65	709.50				
	Total	63						

(underestimation =1; accurate =2)

As shown in (Table 4.7), the results indicate that there was a significant difference at the $p \leq 0.01$ level within the verbal perception (underestimation, accurate) between girls and boys. As shown in the table boys were more likely to be underestimated (mean rank=18.65). whereas the girls were more likely to be accurately perceived (mean rank= 44.14). Similarly, there was a significant difference at the (0.01) level in visual misperception between the girls and boys where the boys were more likely to be underestimated with a (mean rank=23.65) and the girls were more likely to be accurately perceived with a (mean rank= 39.59).

Parents and Grandparents' Gender

To test the relationship between parents and grandparents' gender and verbal and visual weight perceptions, we performed the Spearman correlation test (see Table 4.8). The spearman's correlation test revealed significance at the $p \leq 0.01$ level ($r=0.586$) between the caregiver's gender and verbal weight perceptions and a significant correlation between the caregiver's gender and visual weight perceptions at $p \leq 0.01$ level ($r=0.436$) (see Table 4.8). To determine the nature of this correlation, a Mann Whitney test was performed (see Table 4.9).

Table 4.8 Spearman's Correlations Between the Gender of Caregiver and Verbal, Visual perceptions

		Gender of caregiver	Verbal perceptions	Visual perceptions
Spearman's rho	Gender of caregiver	1.000	.586**	.436**
	Verbal perceptions		1.000	.591**
	Visual perceptions			1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.9 Mann-Whitney Test for differences in verbal and visual perceptions according to Parent/Grandparent's Gender

	Gender of caregivers	N	Mean Rank	Sum of Ranks	Mann Whitney U	Wilcoxon W	z	Sig.
Verbal misperceptions	Female	27	30.41	821.0	97.00	307.0	-4.306-	.000
	Male	20	15.35	307				
	Total	47						
Visual misperceptions	Female	27	28.06	757.5	160.5	370.5	-2.97-	.000
	Male	20	18.53	370.5				
	Total	47						

(underestimation =1, accurate=2)

As shown in Table 4.9, the results indicate that there was a significant difference at the $p \leq 0.01$ level in verbal weight perceptions (underestimation, accurate) between female and male

caregivers. Fathers and grandfathers were more likely to underestimate their child's weight (mean rank=15.35) compared with mothers and grandmothers who were more likely to be accurate in perceiving their child's body weight (mean rank= 30.41). Similarly, there was a significant difference at $p \leq 0.01$ level in visual misperception where fathers and grandfathers were more likely to underestimate their children's weight (mean rank=18.53) compared with mothers and grandmothers who were more likely to be accurate in perceiving their children's body weight (mean rank= 28.06).

Child Age

To test the relationship between child age and verbal and visual misperceptions, we the performed Spearman correlation test (Table 4.10). The Spearman correlation test revealed significance at the $p \leq 0.01$ level (r=0.682) between the child's age and verbal misperceptions and the $p \leq 0.01$ level (r=0.327) between the child's age and visual misperceptions. To determine the nature of this correlation, a Mann Whitney test was performed (see Table 4.11).

Table 4.10 Spearman's Correlations test between Child Age and Verbal and Visual perceptions. (N=63)

		Child's age	Verbal perceptions	Visual perceptions
Spearman's rho	Age of child	1.000	.682**	.327**
	Verbal perceptions		1.000	.591**
	Visual perceptions			1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.11 Mann-Whitney Test for The Differences in Verbal, Visual perceptions According to Child Age

	Child's Age	N	Mean Rank	Sum of Ranks	Mann Whitney U	Wilcoxon W	z	Sig.
Verbal perceptions	5-6 years	30	20.75	821.0	157.50	622.5	-5.369-	.000

	7-10 years	33	42.23	307				
	Total	63						
Visual perceptions	5-6 years	30	26.8	804.00	339.00	804.00	-2.574-	.010
	7-10 years	33	36.73	1212.00				
	Total	63						

(underestimation =1, accurate=2).

As shown in Table 4.11, the results indicate that there was a significant difference at the $p \leq 0.01$ level in verbal misperception between younger children between 5-6 years and the older children aged 7-10 years. Younger children were more likely to be underestimated by their caregivers (mean rank=20.75) compared with older children who were more likely to be accurately perceived (mean rank= 42.23). Similarly, there was a significant difference at the $p \leq 0.01$ level in visual misperception where younger children's weight status was more likely to be underestimated by their caregivers (mean rank=26.8) compared with older children who were more likely to be accurately perceived (mean rank= 36.73).

Anthropometric Factors Contributing to Adult Underestimation of Children's Weight Status

Child's Weight Status

To test the relationship between children's weight status and verbal and visual misperceptions, we performed the Spearman correlation test (Table 4.12). The Spearman's correlation test revealed a significant correlation at the $p \leq 0.01$ level ($r=0.831$) between the child's weight status and verbal weight perceptions and at the $p \leq 0.01$ level ($r=0.592$) between child's weight status and visual misperceptions. To determine this correlation, the Kruskal-Wallis test was performed (see Table 4.13).

Table 4.12 Spearman's Correlation tests between a Child's Weight Status and the Verbal, Visual perceptions.

		Child's Wight status	Verbal perceptions	Visual perceptions
Spearman's rho	Child's Wight status	1.000	.831**	.592**
	Verbal perceptions		1.000	.591**
	Visual perceptions			1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.13 Kruskal-Wallis Test for differences in verbal and visual perceptions according to the weight status of a child

	Verbal perceptions	N	Mean Rank	Chi-Square	df	Sig.
Verbal perceptions	Healthy	32	40.73	34.59	2	0.01
	Overweight	22	15.00			
	Obese	9	31.94			
	Total	63				
	Visual perceptions	N	Mean Rank	Chi-Square	df	Sig.
Visual perceptions	Healthy	32	35.70	13.34	2	0.01
	Overweight	22	21.03			
	Obese	9	36.44			
	Total	63				

As shown in Table 4.13, the results indicate that there was a significant difference at the $p \leq 0.01$ level in verbal weight perception between weight status category (healthy, overweight, obese). Children with overweight were more likely to be underestimated by their caregivers (mean rank=15.00) compared with children with healthy (mean rank= 40.73) and obesity (mean rank= 31.94) who were more likely to be accurately perceived. Similarly, there was a

significant difference at p ≤ 0.01 level in visual weight perception verbal misperception between weight status category (healthy, overweight, obese). Children with overweight were more likely to be underestimated by their caregivers (mean rank=36.44) compared with children with healthy (mean rank= 35.70) and obesity (mean rank= 31.94) who were more likely to be accurately perceived.

Parent and Grandparent's' Weight Status

To test the relationship between parents/grandparents' weight status and verbal and visual perceptions, the Spearman correlation test was performed (see Table 4.14). The Spearman correlation test revealed a significance at the p ≤ 0.01 level (r=0.444) between the caregiver's weight status and verbal weight perceptions and the p ≤ 0.01 level (r=0.364) between the caregiver's weight status and visual weight perceptions. To determine the nature of this correlation, the Kruskal-Wallis test was performed (see Table 4.15).

Table 4.14 Spearman's Correlations Between Parents and Grandparents' Weight Status and Verbal, Visual perceptions.

		Parents/Grandparents' Weight Status	Verbal perceptions	Visual perceptions
Spearman's rho	Parents/Grandparents' Weight Status	1.000	.444**	.364**
	Verbal perceptions		1.000	.591**
	Visual perceptions			1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.15 Kruskal-Wallis Test for Differences in Verbal and Visual perceptions According to the Weight Status for Parents and Grandparents

	Verbal perceptions	N	Mean Rank	Chi-Square	df	Sig.
Verbal perceptions	Underweight	1	38.00	9.533	3	0.02
	Healthy	17	25.56			
	Overweight	21	18.98			
	Obese	8	32.13			

	Total	47				
	Visual perceptions	N	Mean Rank	Chi-Square	df	Sig.
Visual perceptions	Underweight	1	40.00	9.76	3	0.02
	Healthy	17	27.56			
	Overweight	21	18.47			
	Obese	8	28.25			
	Total	47				

It can be seen from Table 4.15, that there was a significant difference at the $p \leq 0.01$ level, in the verbal weight perception category, according to the weight status of caregivers. Caregivers with overweight were more likely to underestimate their child's weight (mean rank=18.89) and caregivers with an underweight, healthy or obese weight status were more likely to be accurate in perceiving their children's weight (mean rank= 38.00, 25.56, 32.13). Similarly, there was a significant difference at the $p \leq 0.01$ level in visual misperception according to the weight status of the child. Caregivers with overweight were more likely to underestimate their children's weight (mean rank=18.47) and caregivers with an underweight, healthy or obese weight status were more likely to be accurate in perceiving their children's weight with a (mean rank= 40.00, 27.56, 28.25) (in which underestimation =1, accurate=2).

Adult's Body Weight Norms and Their Preferences of Children's Weight

Exposure to Obesity

The study then investigated whether this tendency to underestimate a child's weight status may be explained by exposure to other children with heavier body weights. The caregivers of boys aged 5 to 6 years, who reported being exposed to overweight or obese body shapes, were more likely to underestimate their child as being overweight. Similarly, caregivers of girls aged from 5-6 years who reported being exposed to overweight or obese body shapes were more likely to underestimate their child's overweight. However, we were unable to assess whether this tendency to underestimate a child's weight status may be explained by exposure to other

children with heavier body weights in children aged from 7-10 as almost all the participants were not exposed to overweight or obese body shapes.

Perceptions of Average Body Shape and Size in Children Aged 5-6 Years and Children From 7-10 Years

Overall, the caregivers of children of both ages indicated a heightened awareness of what constitutes an average body shape. Overall, 60% of the caregivers of children aged 5-6 years identified the three silhouettes representing children within the healthy weight category as an average body size and 37% identified two silhouettes representing children with underweight as an average body size. In children aged from 7-10 years, 79% of the adult caregivers identified three of the silhouettes representing children within the healthy weight category as an average body size and 12 % identified two silhouettes representing children with underweight as an average body size. Only 6% of the participants identified silhouette (F) which represented children within the overweight or obesity category as an average weight.

Preferred Body Shape and Size in Children Aged 5-6 Years and Children From 7-10 Years

For the children aged 5-6 years, 52% of the caregivers identified the three silhouette representing children within the healthy weight range as a preferred body size. Whereas 48% selected silhouettes represent an underweight as their preferred body size. In children aged from 7-10 years, 64% of the caregivers identified the two silhouette representing children within a healthy weight range as the preferred body size. Whereas 36% selected silhouettes represent an underweight as their preferred body size. No participant selected silhouette representing children with overweight as a preferred body shape.

Weight Bias Internalisation

To test the relationship between weight stigma internalisation and verbal and visual misperceptions, we performed spearman correlation (see Table 4.16). The Spearman correlation test revealed negative significance at the $p \leq 0.01$ level ($r = -0.682$) between internalised weight stigma and verbal misperceptions and significance at the (0.01) level ($r = -0.563$) between internalized weight stigma and visual misperceptions. To determine the nature of this correlation, a Kruskal-Wallis test was performed (see Table 4.17).

Table 4.16 Spearman's correlations between weight stigma internalization and verbal, visual perceptions.

		Weight Bias Internalization	Verbal Perceptions	Visual Perceptions
Spearman's rho	Weight Bias Internalization	1.000	-.682**	-.563**
	Verbal Perceptions		1.000	.591**
	Visual Perceptions			1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.17 Kruskal-Wallis Test for Differences Between Verbal and Visual perceptions and Weight Bias Internalisation

	Verbal Perceptions	N	Mean Rank	Chi-Square	df	Sig.
Weight Bias Internalisation	Underestimation	26	35.83	23.22	1	0.00
	Accurate	25	15.78			
	Visual Perceptions	N	Mean Rank	Chi-Square	df	Sig.
Weight Bias Internalisation	Underestimation	34	31.85	15.84	1	0.00
	Accurate	17	14.29			

It can be seen from Table 4.17, that there was a significant negative correlation at $p \leq 0.01$ between weight bias internalisation and verbal weight perceptions. The participants who had

high levels of internalized weight stigma were more likely to underestimate their children's weight (mean rank=35.83) and participants who had a low level of internalised weight stigma were more likely to be accurate (mean rank=15.78). Similarly, a significant negative correlation at the $p \leq 0.01$ (r=-0.563) was found between internalised weight bias and visual weight perceptions. The participants who had high levels of internalized weight stigma were more likely to underestimate their children's status (mean rank=31.85) and the participants with a low level of internalised weight stigma were more likely to be accurate with a (mean rank=14.29).

Negative Emotions Associated with A Child Being Categorised as Obese

To test the relationship between fear of fat and verbal and visual misperceptions, the study performed Spearman correlation test (see Table 4.18). The Spearman correlation test revealed negative significance at the $p \leq 0.01$ level (r= -0.716) between fear of fat and verbal weight perceptions and the $p \leq 0.01$ level (r= -0.749) between fear of fat and visual misperceptions. To determine the nature of this correlation, a Kruskal-Wallis test was performed (see Table 4.20).

Table 4.18 Spearman's correlations between fear of fat and verbal, visual perceptions.

		Fear of Fat	Verbal Perceptions	Visual Perceptions
Spearman's rho	Fear Of Fat	1.000	-.716**	-.749**
	Verbal Perceptions		1.000	.591**
	Visual Perceptions			1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.19 Kruskal-Wallis test for differences between verbal, visual perceptions according to fear of fat

	Verbal Perceptions	N	Mean Rank	Chi-Square	df	Sig.
Fear of fat	Underestimation	27	35.91	25.60	1	0.00

	accurate	24	14.85			
	Visual perceptions	N	Mean Rank	Chi-Square	df	Sig.
Fear of fat	Underestimation	34	33.78	28.06	1	0.00
	accurate	17	10.44			

The results on Table 4.19, indicate a significant negative correlation at the $p \leq 0.01$ level ($r = -0.716$) between fear of fat and verbal weight perceptions. The participants who had high levels of fear of fat were more likely to underestimate their children's weight status with a (mean rank=35.91) and participants who had a low level of internalised weight stigma were more likely to be accurate at a (mean rank=14.85). Similarly, a significant negative correlation at the $p \leq 0.01$ level ($r = -0.749$) was found between fear of fat and visual misperceptions. The participants who had high level of fear of fat were more likely to underestimate their children, with a (mean rank=33.78) and the participants who had a low level of fear of fat were more likely to be accurate (mean rank=10.44).

4.5 Discussion

Unfortunately, research continues to show that overweight and obesity often go under-recognised. Significant levels of parental and personal underestimation of overweight status are demonstrated in this paper. In personal evaluation, one third of parents and grandparents underestimated their own overweight status both verbally (34%) and visually (29%). Several studies have shown similar high misperception rates, with 35% (n=369) of adults in study 2 incorrectly perceiving their own overweight status to be within the healthy weight range (Yang *et al*., 2021; Wu *et al*., 2021).

Similarly, in parental evaluation, nearly half of the parents and grandparents underestimated the overweight status of their 5-6 years old children or grandchildren when asked using the

verbal scale and around 71% of the parent or grandparent participants underestimated when using the visual scale. In children aged 7-10 years, 42% of caregivers underestimated their child/grandchild's overweight status verbally and 59% visually. Although the result of this study is comparable to previous studies (Moschonis *et al*., 2011) using the same age group. However, the reason for such high rates of visual underestimation in our study may be due to the use of visual scales which parents or grandparents may find difficult to properly position their child within the given spectrum where the figure scales given were on 7 silhouettes than when using a more descriptive written scale. However, to the author knowledge, there were no other validated scale to be used for such age groups.

Doolen *et al*., (2009); Towns and D'Auria, (2009) and Rietmeijer-Mentink *et al*., (2013) state that a true understanding of why parents underestimate their children's overweight status is lacking, despite the certainty that parents generally misperceive the overweight status of their children irrespective of parents or children's cultural and national background or age, and do not classify themselves as obese or overweight, as per a significant body of evidence, but little is known about why parents do this. The purpose of this study was to empirically investigate the relationship between sociodemographic, anthropometric, and psychological factors in adult underestimation of overweight and obese weight status of children.

An understanding of why parents do not view their overweight child as overweight will help healthcare professionals develop a positive alliance with parents to address child obesity and its associated health consequences. Younger children (5-6 years old) were more likely to be underestimated than older children (7-10 years). This finding further confirms the result of previous studies reporting that, decreasing age was accompanied by the percentage of underestimation of overweight status in children increasing (Eli *et al*., 2014; Hudson *et al*., 2012; Lundahl *et al*., 2014). As noted by Lundahl *et al*., (2014), the desire for viewing a slight

excess of weight or a child having excess weight as something they will grow out of or even as a signal of normality and good health, could contribute to the mentioned phenomenon regarding age and weight status. An important implication for this finding may be to encourage healthcare professionals to evaluate parental concerns and perceptions regarding child weight estimation from an early stage and engaging the parents of young children in early discussions about what actually healthy weight is and how having a healthy weight can result in future health.

This study supports the idea that parents are more likely to underestimate the weight status of boys than girls. These results corroborate the findings of a significant amount of previous work (Maynard *et al*., 2003; Campbell *et al*., 2006; Alshahrani *et al*., 2021). This may indicate a gender difference in perceiving embodiment and body composition and awareness, but it also seems likely to reflect the contextual social values of the target respondents. Mothers may be more sensitive to girls' weight and body image issues, while boys' overestimation may be considered to have physical benefits (Moschonis *et al*., 2011). Clemente *et al*., (2005) note that a larger body size of boys is more widely accepted than for girls where lower weights are more sought after due to social and media norms and messaging, thus, offering an explanation for the above-mentioned findings.

Additionally, the underestimation of the overweight status of a child by parents or grandparents was discovered to be more probable when the parents or grandparents were with overweight. Pasch *et al*., (2016) observe that the normative change in view regarding what overweight signifies in a family alongside parents avoiding and resisting acknowledgement of the fact that they themselves are carrying extra weight or that their children are with overweight explicate the mentioned tendency. As McPherson *et al*., (2016) highlight, another factor may be that caregivers or parents that have or had a high BMI value wish to safeguard

their children from the uncomfortable experience of being impacted by social stigmas that can come from the label of being overweight or obese, more so than parents who were under or within the bounds of healthy weight. Parents and grandparents tended to underestimate excess weight if the child was with overweight than obesity. It seems possible that these results are because parents being able to identify an extreme amount of overweight but may not be worried by a small amount of overweight (Lundahl *et al*., 2014).

To date, little evidence has been found associating caregivers' gender with the underestimation of child overweight (Hudson *et al*., 2012). Our findings show that fathers and grandfathers were more likely to underestimate their child's body weight than mothers and grandmothers. However, the reason for this difference is still unclear. Future studies, perhaps qualitative in nature, are recommended to further investigate parental gender discrepancies in results regarding misperception of child's weight status. This difference between mothers and fathers is an important point to consider when addressing parental misperceptions (Hudson *et al*., 2012). It has been suggested that caregivers may underestimate their child's weight if they actually prefer a heavier child (Pasch, 2016). Surprisingly, in the current study the majority of caregivers selected sketches that represent healthy body weight as their preferred body weight for children from both age groups. Different age group and ethnicity between this study and the study by Pasch, (2016) may account for this result. Similarly, when assessing the association between average body weight perceptions and underestimations of child weight, no participant selected sketches that represented overweight or obese weight status as an average body shape. Instead, 60% of the caregivers of children aged 5-6 years identified the two silhouettes representing children within the healthy weight range as an average body size. A further 37% identified two silhouettes representing children with underweight as an average body size. In children aged from 7-10 years, over three-quarters of

the adult caregivers identified three of the silhouettes representing children within the healthy weight as an average body size. Although it seems encouraging that parents and grandparents understand how healthy weight look like and can see that healthy weight is an average body shape, however, this study can be repeated with larger sample size and with wider ethnicity in order to further investigate these factors.

There is a significant stigma associated with the sensitive matter of obesity, such as being labelled as obese or overweight. Puhl *et al*., (2007) emphasise that avoidance of medical care, avoidance of physical activity, feelings of loneliness and worthlessness, poor body image and body dissatisfaction, maladaptive eating tendencies, stress-induced pathophysiology, anxiety and other psychological disorders, low self-confidence and self-esteem, and depression are all correlated to stigmas regarding obesity and being overweight. As a result of such stigmas and biases, those who are overweight or obese engage in self-directed shaming and negatively stereotyping of themselves more and more following the internalisation of such stigmas and negative perceptions, as per findings in the literature. Essayli *et al*., (2017) also note that maladaptive health behaviours, binge eating, and a poor quality of life, regarding health alongside poorly self-reported health, can result from the internalisation of weight stigmas.

In addition, evidence shows that the identification of overweight is associated with internalised weight stigma and greater body dissatisfaction (Essayli *et al*., 2017). In our study, the participants who had high levels of internalised weight bias were more likely to underestimate their children's weight. A question be asked regarding, why caregivers who had high levels of internalised weight stigma might be more likely to underestimate their children's weight? A complete explanation requires further study, but it may be because caregivers had been subjected to social stigma and possibly wanted to safeguard their children from the obese or overweight label, thus protecting them from similarly uncomfortable life experiences

(McPherson *et al*., 2016).

Previous studies have reported that medicalized terms such as obesity are consistently considered undesirable (Hirschfeld-Dicker *et al*., 2018) due to the associated negative attitudes. Obesity is associated with negative emotions as it has been suggested that the fear of stigma and the desire to protect against this threat may stand as a barrier to accurate bodyweight status identification (Robinson and Hogenkamp, 2015).

An important finding was that caregivers who had a high level of fear of categorizing their children as being obese (fear of fat) were more inclined towards underestimation of child weight. This can be attributed to multiple factors and rationales. This is usually the case in order to avoid healthcare professionals placing blame on the caregivers, due to their children's weight issues as well as safeguarding their children against the negative stigmas regarding being labelled overweight or obese are among the reasons that explain the aforementioned premise. The rationalisation of difficult beliefs in order to diminish them is one possibility, in line with the theory of cognitive dissonance (Ciao *et al*., 2011). Additionally, there is an unfounded belief that the children will grow out of whatever weight issues they have (Ruiter *et al*., 2020). One qualitative study has suggested that caregivers are more likely to be angry and defensive when they receive information about their child's excessive weight and more likely to accept the children's visual or hearing problems than excess body weight (Hudson, 2012). This demonstrates how the perception of childhood weight and overweight is an extremely sensitive topic for parents and caregivers. The lack of identifying children as being overweight by caregivers can also be a symptom of the altering social norms that obfuscate the matter in the context of rising rates of obesity. Pich *et al*., (2015) stress that resistance and negative emotions may be provoked alongside a tense cognitive dissonance within caregivers as a result of an overweight diagnosis of a child, which makes it critical to synchronise beliefs

and being sensitive in order to reduce suffering.

The root problems that cause parental underestimation must be determined and resolved alongside the dismantling of the negative stigmas regarding excessive weight in order to unify and align perception with reality. The misperception and underestimation of body weight is an issue that has not been resolved when interventions occur in families with obese and overweight children, even to this day. Nonetheless, misperceptions regarding body weight could be resolved via the creation and evolution of communication programmes and educational tools that follow the example of the intervention to combat eating disorders which centre upon diminishing cognitive dissonance and stigmas with great success.

Hardus *et al*., (2003) note that accurate classifications, by caregivers, of the overweight status of their children is not being achieved by public health campaigns, despite the gains made in increasing child obesity awareness. The complex problem of child obesity and the misperceptions plaguing the matter could be addressed via further investigating the basic and core questions regarding why misperceptions occur in caregivers, how they occur, and who they occur to. As Katz, (2015) emphasises, if one does not know an issue exists, one cannot fix it. Nonetheless, averting increased victim blaming or stigma is crucial and must be considered when elevating parental awareness. Efforts to diminish misperceptions regarding child weight alongside reducing the social stigma and images of obesity must occur in tandem with efforts to raise awareness.

4.6 Limitations

The correlations presented in this paper can go in both directions given that causal interpretations or analyses were not possible due to the cross-sectional nature of this paper. The weight and height of the parents or caregivers and their children were self-reported as part of the measures data. Pursey *et al.,* (2014) note that self-reported measurements of weight and height via the internet

have become a viable option for collecting such data, despite objective measurements of weight and height being optimal. Moreover, certain variables and the correlations between them may not have achieved statistical import due to the small sample size in this paper. The generalisation of the findings of this study should be carried out with care as the respondents in this paper may have been impacted by the cultural norms and perceptions of being from the United Kingdom. Exclusively using BMI to define child, parents and grandparents weight category is another limitation of this study. Although BMI is widely used in different settings however, it is possible that other factors such as body fat distributions or the amount of child's muscle have an effect on parental perceptions about their child's weight status. Despite these limitations, the key strength of this study is that this study the first attempts to thoroughly examine the concept of fear of obesity diagnosis and parental underestimation of child weight status. In addition, validated scales were used in order to guarantee that psychological techniques were assessed with an adequate degree of sensitivity. Moreover, while a majority of the previous studies included only mothers' perceptions of their children's weight, the current study included wider familial perceptions from parents, including fathers, and grandparents which provided a deeper insight into the issue. Combining psychological, anthropometric, and sociodemographic elements to better understand the underestimation by adults of the overweight or obese status of children is a unique approach implemented in this paper, not seen in the literature to the best of the author's knowledge.

4.7 Applied implications

The issue of parental weight misperceptions of children has received considerable critical attention. In the UK, NCMP is a strategy measures weight and height of children at this data is used to increase parental awareness and for population-level surveillance. Although, this strategy has shown promising result however, the actual action is still limited. This may be associated with how parents reacted to the NCMP weight feedback. A study by Falconer *et al*., (2014) reported that some parents

see this feedback a helpful tool while others reported feeling upset and guilty in response to the feedback. Therefore, it is suggested here that a careful consideration should be taken when developing weight feedback; rather than focusing on weight loss as the goal, it may be more helpful to focus on promoting healthy behaviors and habits that can support overall health and well-being. Using language that is non-judgmental and supportive can help to create a more positive and accepting environment for people to discuss their weight and work towards making healthy changes. In a wider context, it is important for parents to be aware of their child's body weight and the potential health risks associated with childhood obesity in order to promote proper health and weight management (Falconer *et al.,* 2014). Early recognition of when a child's BMI or weight falls outside the healthy range for their age can allow for the implementation of educational, preventive, and therapeutic interventions (Woods *et al., 2020*).

4.8 Conclusion

Features that influence the underestimation of the overweight status of children by children and parents alike are determined in this paper. The underestimation of child weight has been associated with demographic, anthropometric, psychological factors. Future studies, prevention tactics, and primary care should consider such elements. The topic of obesity management is laden with inconsistent and often opposing messages that obfuscate the matter rather than clarify it, making the formation of beliefs and decisive action complicated as parents navigate through the wider social context. In addition, the perception of the weight status of caregivers' children and obesity can be negatively impacted by the stigmas, images, and stereotypes regarding obesity. Obstacles that hinder the accurate identification of the weight status of children, and specifically focused initiatives to heighten obesity awareness can all be facilitated and encouraged via increased comprehension of the elements linked to rates of underestimation. The challenge of child obesity could be overcome by broadening the

comprehension of how misperception occurs in parents, who they occur in, and why they occur in parents regarding the overweight status of their children. Previously unexplored factors linked to misperception by adults, of the overweight status of children, were determined in this paper. Such elements can be the focus of future studies while benefit prevention tactics and primary care. Nonetheless, such correlations must be studied in further detail in papers specifically designed to investigate such phenomena.

Chapter 5: General Discussion and conclusion

5.1 Introduction

Weight underestimation is a major problem which has repeatedly been documented in studies that have assessed personal and parental perceptions of overweight status. This underestimation is a clear barrier to the management and prevention of overweight and obesity, and represents a possible new target in the obesity therapy model (Manios *et al.*, 2015; Ruiter*et al.*, 2020). It has been proposed that weight-related communication is a potent tool that is able to assist patients in realising that overweight and obesity could adversely affect their well- being (Speer and McPhillips, 2018). The patient- healthcare provider relationship is a cornerstone of patient adherence and compliance, and this relationship may be threatened by misaligned perceptions of the situation. One solution to this problem is to investigate the factors associated with parental and adult personal underestimation of overweight status. A deeper understanding of these factors may facilitate recognition of overweight, and therefore help in improving weight related communication and future weight management.

This discussion will firstly provide an overview of the main findings from each chapter before considering the theoretical implications and applied relevance of this work to policy and practice. The strengths, limitations and future directions of the research will then be considered before presenting a final conclusion.

5.2 An overview of studies

The main aim of this thesis was to investigate the factors associated with parental and adult personal underestimation of overweight status. This thesis includes three studies, a systematic review and meta-analysis, and two experiential papers. A summary of each study is presented in the following figure.

Figure 5.1 Figure illustrating summary of the three studies included in this thesis.



This result of this thesis confirms that underestimation of overweight status is highly prevalent among adults, parents of children with overweight and obesity, children themselves and healthcare professionals. The reason of such high level of underestimation is still unclear, however, this thesis found unexplored factors that are associated with underestimation of overweight status. These factors include psychological, anthropometric, and sociodemographic elements each factor is discussed below.

Age

Study 1 and 3 in this thesis confirms that children with overweight/obesity at younger ages are more likely to be underestimated. More specifically children age from 2 -5 years old. The present result is significant in at least two major respects. First, it suggests that there is an urgent need to assess parental perceptions and concerns of their children's weight from an early stage. Following this, regular follow-ups, providing a continued and systematic assessment and feedback on child weight over time would help the parents to be aware of their child weight status and engage early in a suitable weight related intervention for their children. Second, parent's understanding of the health risks associated with obesity and weight problems from early stages can impact their willingness and motivation to take action.

This finding broadly supports the work of other recent and old studies linking age with overweight underestimation. Age was accompanied by the percentage of underestimation of overweight status in children increasing (Hudson et al., 2012; Eli et al., 2014; Lundahl *et al.,* 2014; Dzielska *et al.,* 2022). It is encouraging to compare this result with that found by a recent study conducted by Ruiter *et al.,* 2020, who examined parental perceptions of children aged 2–12 years, aged in 2009 (n = 8105), 2013 (n = 8844) and 2017 (n = 11,022) using a community-based survey. Th result demonstrated that parents of children aged from 2- 7 years were more likely to underestimate their child overweight status than parents of older children. Although this study used a validated questionnaire and had a large sample

size however, it does not provide information on how the authors dealt with their missing data given that 9% of parents did not provide their child's height and/or weight when completing the questionnaires. On the other hand, some researchers have found no differences by child age (Carnell *et al.,* 2005). The serious consequences of childhood obesity at early age highlight the urgent need to address this issue. This is because children are still developing weight-related habits and are relatively adaptable.

Gender

Gender factor is same important as age, being a parent of boys or being male adults has been linked with more underestimation of overweight status in this thesis. In another word, the larger body size of boys is more widely accepted than for girls. These results corroborate the findings of a significant amount of previous work (Maynard *et al.,* 2003; Campbell *et al.,* 2006; Alshahrani *et al.,* 2021). This may indicate a gender difference in perceiving embodiment and body composition and awareness, but it also seems likely to reflect the contextual social values of the target respondents. Mothers may be more sensitive to girls' weight and body image issues, while boys' overestimation may be considered to have physical benefits (Moschonis *et al.,* 2011). Clemente *et al.,* (2005) note that a larger body size of boys is more widely accepted than for girls where lower weights are more sought after due to social and media norms and messaging, thus, offering an explanation for the above-mentioned findings. In a very recent study Lotrean *et al.,* 2022, 880 children (445 girls and 435 boys) were included. In this study weight misperceptions were assessed by asking parents "How do you find your child's weight?" (An appropriate weight for his/her age, Too big, or Too small) according to their gender. Around 40% of parents underestimated their boys overweight status comparing with 30% of girls. Yet, these data must be interpreted with caution because this study was conducted in Romania and the generalisability of these results may be limited. It seems possible that these results are due to the socially accepted view

that girls are deemed to be slim, whereas underweight boys are considered weak. In contrast, some researchers have found no differences by child gender (Admes *et al.,* 2005)

Ethnicity and cultural differences

Another important finding in this thesis is that ethnicity and cultural differences were among the factors that are associated with overweight underestimation. Study 1 demonstrated that in some ethnicity such as Hispanic and African American, overweight is considered to exhibit signs of prosperity, good health, or attractiveness. In accordance with the present results, previous studies have demonstrated that around 70% of adult Saharawi refugees who were with overweight, and obesity are happy with their current weight and did not want to have a smaller body size (Naigaga *et al.,* (2018). Therefore, it is essential for weight intervention approaches to consider cultural and contextual factors that may influence how body weight is perceived and that could negatively impact weight management and associated health outcome. Furthermore, given that family-based intervention has been suggested as one of the most successful methods for managing and treating childhood obesity, investigating a broader familial perspective such as grandparents can help to gain further insights into the barriers to weight related intervention. In many countries particularly in the UK, grandparents are key providers of child-care. Previous studies have shown cultural preferences or beliefs among some grandparents that contribute to a preference for an overweight child. For example, in some cultures, it may be seen as a sign of prosperity or good health for a child to be overweight. This belief may lead grandparents to encourage or even celebrate a child's excess weight which can result in poor recognition of children's weight status (Naigaga *et al*., 2018). Considering other family members' perceptions, e.g grandparents can help to resolve familial barriers to treatment.

Educational level

This thesis (study 1 and 3) suggests that parents with higher levels of education are more likely to accurately perceive their child's weight status and take action to promote healthy behaviors. This is thought to be because parents with higher levels of education are more likely to have access to information about healthy eating and physical activity and are better equipped to understand how these factors impact their child's health. This is in line with De Hoog *et al.,* (2012), who suggested that less-educated mothers were more likely to underestimate their children's weight than mothers with higher education. However, it's important to note that parental education is just one factor that impacts child weight status and parental perception of weight. Other factors such as socio-economic status, race, ethnicity, and cultural factors may also play a role. Therefore, it's important for healthcare providers and policymakers to address these systemic barriers and work towards promoting equitable access to education and resources to support healthy behaviors for all children.

Fear of obesity diagnosis

Perhaps the most interesting findings of this thesis is the association between fear of obesity diagnosis, and overweight underestimation. Study 2 and 3 of this thesis demonstrated that negative emotions associated with obesity diagnosis is associated with underestimation of overweight status in adult and children. As it mentioned earlier, obesity is a sensitive issue because it is associated with stigma. Negative emotions of being labelled as "fat" or ''obese'' are highly stressful, and this leads to a greater risk of depression, anxiety, and low self-esteem. The association found in this study may stem from a desire to avoid the stigmatization that people with overweight/obese face. In other words, there is a conscious and subconscious effort to escape or avoid the discrimination that people who are larger in weight experience. So far, however, no research has been found that surveyed this association hence

the importance of this study. This result suggests there would therefore seem to be an urgent need for focusing on the psychological factors that may influence weight underestimations.

Exposure to obesity and Perceptions toward an average body size

Biases and social norms are significantly implicated when evaluating bodyweight status. Study 2 and 3 of this thesis clearly indicated that individuals who are exposed to obesity in their everyday life are more likely to underestimate their overweight status. These results reflect those of Robinson *et al.,* (2014) who also found that exposure to obesity resulted in an overweight male being underestimated and perceived to be of healthier weight. The observed correlation between exposure to obesity and underestimation of overweight status might be explained in the way that the exposure to obesity in everyday life can change weight perceptions and alter public perceptions of what a 'healthy' weight looks like.

Study 2 in this thesis also suggests that the participants who selected an overweight silhouette as an average body shape were more likely to underestimate their overweight status. When individuals are surrounded by people who are overweight, they may perceive that body size as the "average" or "normal" body size, which can lead to underestimation of their own weight status. This phenomenon is sometimes referred to as "normative misperception" and can contribute to a lack of awareness of the health risks associated with overweight and obesity. Additionally, cultural ideals and media representations of body size and shape can also influence perceptions toward average body size. For example, if media portrayals consistently depict thin bodies as desirable, individuals may be more likely to perceive thinner body sizes as the "average" or "normal" body size, which can lead to overestimation of their own weight status.

Therefore, these results suggest that it is important to address these perceptions and promote accurate perceptions of weight status to help individuals make informed decisions about their health. This may

include education and awareness campaigns that promote healthy body image and provide accurate information about the health risks associated with overweight and obesity. Additionally, healthcare providers can play a role in addressing overweight underestimation by providing accurate assessments of weight status and working with individuals to develop personalized plans for achieving their health goals.

Research method (verbal vs visual)

Study 1, 2 and 3 suggest that the use of visual scale (body image figures, silhouettes or pictures), seems to be more accurate and may be perceived more neutral than the verbal scale. In the context of weight related communication and practice-based research, using the visual scale approach rather than verbal scale, in diagnostic discussions, may produce better clinical outcomes. A study by Pulvers *et al.,* (2008) shows promising results as the use of the visual scale was positively associated with better weight outcomes as it can facilitate weight communication and increase healthcare professionals' confidence when discussing weight issues. Similarly, a previous study by Shinitzky and Kub, (2001) suggested that the use of the visual scale that was attached to BMI categories after short motivational interviewing was recommended for improving recognition of weight status and developing healthcare provider-patient communication. However, it is important to use visual scales in conjunction with other assessment methods to ensure accuracy and reliability.

5.3 Theoretical Implication

The practice of nutritional science is underpinned by evidence-based concepts, together with a robust association between hypotheses and studies. According to this ideology, the paradigms associated with views of weight will be evaluated. The results presented in this thesis have several significant theoretical implications.

1- Visual Normalization Theory

This theory suggests that, with this dramatic increase in overweight and obesity, a population's visual weight perceptions have changed. In other words, as overweight and obesity have increased, and have become more widespread, larger physical body sizes have become normalized which has led to the underestimation of overweight status (Robinson, 2017). This theory was based on evidence suggesting that weight perceptions are based on an individual's body weight norms, and these norms are moulded by the size of the bodies that people are exposed to in their everyday life. In study 2 of this thesis, an examination was conducted regarding whether exposure to obesity in everyday life resulted in the underestimation of an adults own overweight status. The results clearly support this theory, demonstrating that being exposed to obesity in everyday life results in adult underestimation of their own overweight. Likewise, in study 3, parents of children with overweight were more likely to underestimate their child weight if they were exposed to children with obesity in their everyday life. This finding is in accordance with findings reported by Maximova *et al.,* (2008), which suggest that children and adolescents who are exposed to obesity in close proximity to parents or friends and schoolmates, may result in more weight misperceptions of what a healthy weight status looks like. Furthermore, Johnson *et al.,* (2008) examined changes of public weightperception in children over eight years old, primarily in Great Britain. The result of this study further supports the visual normalization theory, as it proves that as the percentage of people with overweight/ obesity increases, the ability to correctly identify overweight decreases. Similarly, the results of studies 1, 2 and 3 further support this theory, as they may explain why parents of boys with overweight, and male adults with overweight, are more frequently underestimated, compared to girls or adult females with overweight. Gender discrepancies in visual body size norms may be impacted by media representations of the two sexes. Women presented inthe media have a higher incidence of low

BMI rates than their male counterparts (Uchôa *et al.,*2019; Mahon and Hevey, 2021). Exposure to these unrealistic models in the media could downsize the norm of body dimensions for females and give rise to a more precise recognition of women who carry excess weight, or potentially lead to weight being assessed as heavier than reality. A number of publications, which have noted that contact with the skinny body form, observe that the media has a negative impact on body acceptance and that this could be a consequence of visual norms (Byrd-Bredbenner and Mundray, 2003; Hawkins *et al.,* 2004; Harper and Tiggemann, 2008; Bessenoff, 2015; Uchôa *et al.,* 2019; Mahon and Hevey., 2021). Several studies have also demonstrated a correlation between media use and clinical manifestations of eating disorders (Harrison, 2000; Malkin *et al.,* 1999).

1- Weight Based Social Identity Threat Theory

The weight-based social identity threat is a psychological condition in which someone is worried that they have been or may be or will be negatively labelled, degraded, rejected, stigmatised or discriminated against, as a result of their weight (Hunger *et al.,* 2015). In such scenarios, the threat originates from the person's cognizance that they could be determined to be in an overweight classification, and consequently be the subject of the negative connotations related to this social group.

Individuals with overweight and obesity are subject to discrimination and bias because of their bodyweight. Parents of children with overweight have also been observed to be discriminated against, rejected, or negatively stereotyped and socially threatened because of their children's overweight (Barry *et al.,* 2012). Parents of children with overweight and or obesity may be fearful of their child being stigmatized. They are also highly sensitive to the attitude and the language of healthcare professionals, which may be perceived as critical (Haqq*et al.,* 2021). These sources of threat may represent a barrier for correct identification of overweight status. Thus, the Social

Identity Threat Theory can serve to explain the association between fear of obesity diagnosis, and the underestimation of overweight status by parents of children and adults in personal evaluation. As shown in the results of study 2 and 3, underestimation of weight status was positively associated with negative emotions associated with obesity diagnosis. Adults who had high levels of fear of fat were more likely to underestimate their overweight status. Similarly, parents who had had high levels of fear of fat were more likely to underestimate their child's overweight status. Weight based social identity threat may explain our observation. The researcher can speculate that this might be due to a defensive mechanism to avoid the threat of being devalued, discriminated against, or negatively stereotyped because of their belonging in a specific social group. Similarly, underestimation of child weight by parents may be a result of the defensive mechanism to avoid being blamed for their child's weight issues (Turner *et al.,* 2012; Eli, *et al.,* 2014). Using weight labelling such as "overweight" or "obese" may increase parental fear of stigmatizing their children (Turner *et al.,* 2012).

This thesis has brought attention to the concept of weight labelling and the potential for adverse consequences from being labelled as overweight or obese. Previous literature has explored the psychological and behavioral impact of weight labelling. Earlier publications have investigated the mental and behavioral consequences of using such terminology (Swami, 2015). Since body weight is entwined with social and cultural constructs that imply appraising facets of one's persona, it can be a complicated and demonstrative subject for discourse (Puhl, 2020). The language utilized to represent concepts of body weight caninfluence beliefs, mindset and activities. Experimental studies have demonstrated that brief contact with words connected to body image can precipitate reflex assessments and decisions regarding body habitus and weight, stimulating detrimental psychological and socialreactions (Watts *et al.,* 2010). These adverse links are an indication of a wider societal weight stigma. Consequently, this has a penetrating effect on the notion that

contemporary research should objectively indicate the worldwide dissemination and existence of weight prejudice in both low- and high-income nations throughout the globe (Brewis *et al.,* 2018). In Study 1, it was noted that the language employed by parents in the qualitative interviews, when they were asked about their children's weight, is markedly different to that used in written assessment methods. Parents show a strong desire to avoidmedical terminology, and commonly describe their children in terms other than obese such as "big boned", "thick" and "solid", which may be a defense mechanism against weight stigma. It is recommended that healthcare professionals use neutral terms such as "healthier weight", or it may be more appropriate to ask patients/ parents in case of children, or even children themselves, about their preferences when discussing weight issues. Using such methods may improve weight related communication, lead to an easier discussion, and. as a result, better weight management outcomes.

5.4 How the findings of this thesis should influence future policy and practice?

1. Giving that the result of study 1 in this thesis suggested that healthcare professionals often fail to identify overweight and obesity in their patients. It is crucial to identify strategies to improve identification of at-risk patients. Training that helps healthcare professionals (HCPs) to develop the skills, knowledge, and confidence needed to have conversations about weight can make it easier for HCPs to bring up this topic with patients and families. This can be helpful in supporting patients in making healthy lifestyle changes and achieving their weight management goals. Furthermore, training that focuses on increasing awareness of the biases and stigma that patients may encounter from healthcare professionals (HCPs), and promoting the use of people-first language, can help to improve the patient-HCP relationship and enhance patient health outcomes. In addition, as we know that the current evidence of the aetiology of obesity and the best and effective intervention is still ongoing prosses, it is also important for healthcare professionals (HCPs) to continue their professional development in order to stay up-to-date on

the latest evidence on the causes of obesity and the most effective interventions. Using standardized skills in this process can help to fill in any gaps in knowledge and produce highly trained HCPs. To support this effort, clear guidelines, courses, and programs that provide a deeper understanding of obesity are needed.

2. The findings reported here may help increase awareness among healthcare professionals by demonstrating that parents continue to underestimate their child's weight status, particularly among parents of boys more than girls, gender-based weight related recommendations are likely to be optimally successful instead of general weight related recommendations. Interventions that target the impact of exposure to idealized bodies in the media, and how this exposure may alter how men and women want to look and perceive their own bodies, may be necessary.
3. The findings reported in this thesis may help increase awareness among healthcare professionals by demonstrating that parents continue to underestimate their child's weight status, particularly at younger ages. This is an alarming finding, given that both overweight and obesity are easier to prevent and reverse in younger children. Regular weight and height measurements can help healthcare providers accurately assess a child's weight status and track changes over time. This can help identify potential weight-related health problems early on and provide appropriate interventions and treatments. Education and awareness campaigns can also help parents and caregivers better understand the importance of accurate weight assessments and the potential health risks associated with overweight and obesity. This can include information on healthy eating habits, physical activity, and other lifestyle factors that can impact weight status. In addition, parental involvement is crucial in preventing weight underestimation of young children. Parents and caregivers should be encouraged to actively participate in weight

assessments and to make healthy lifestyle changes to promote their child's health.

4. Fear of obesity diagnosis is suggested to be associated with overweight underestimation, which suggests that news related to weight may elicit negative reactions in various forms, such as fear, guilt, denial, anger, confusion, and shock. In the UK, National Child Measurement Programme (NCMP) feedback is one way to provide parents with their child's weight, therefore, it may be helpful to adopt a more neutral tone by providing parents/grandparents with information recognising the complex nature of the environment in which children live. Furthermore, it is important to understand the preferences and emotional responses of parents to National Child Measurement Programme (NCMP) feedback, and to take the sensitive nature of weight issues into account when devising feedback. To address this, it may be useful to allow local areas to modify their feedback letters to better meet the needs of their populations. Additionally, it is recommended to place less emphasis on body weight and instead focus on behaviors that are both health-protective and support weight management. By promoting behaviors such as reducing sugar-sweetened beverage consumption and increasing physical activity to all individuals, regardless of weight status, messages about healthy behaviors can be less stigmatizing and address the need for prevention of overweight and obesity. Another important point to consider in this context is the concept of "othering" when examining parents' responses to feedback about their child's weight. Parents may feel that they are not the intended audience for such feedback because of their education level, social class, or interest in their child's health, and may perceive the feedback as being aimed at "others" - those who are perceived as being irresponsible and not following healthy living advice. This can contribute to feelings of guilt or shame and may make it more difficult for parents to accept and act on the feedback. It is therefore important to approach this issue

in a way that is sensitive to the potential for "othering" and works to foster a sense of inclusivity and support for all parents. Similarly for adults, according to the National Institute for Health and Care Excellence in the UK, healthcare professionals should encourage adult primary care patients to check their weight, but they should also be mindful of the potential to stigmatize individuals with negative self-perceptions of their weight. To increase patient compliance and motivation for health management, it is important to have supportive and empathetic conversations that take into account patient and caregiver preferences and cultural beliefs.

5. Healthcare providers should approach weight assessments with sensitivity and a non-judgmental attitude to create a supportive and safe environment for families. This can help reduce feelings of shame or embarrassment and encourage open and honest communication.
6. It is important to be culturally sensitive when assessing weight status, as cultural ideals and perceptions of body size and shape can vary widely. Healthcare providers should be aware of cultural differences and adapt their approach to weight assessments accordingly.
7. The use of visual scale (body image figures, silhouettes or pictures), seems to be more accurate and may be perceived more neutral than the verbal scale. In the context of weight related communication and practice-based research, using the visual scale approach rather than verbal scale, in diagnostic discussions, may produce better clinical outcomes.

5.5 Strengths and limitations

The use of mixed method systematic review in study 1 with a relatively large number of articles reviewed and included and including more parties (children, parents and healthcare professionals) is a notable strength of this thesis as it has enabled us to understand a fuller

picture of these phenomena. In addition, the data collected for this thesis depended on validated scales and tasks where it was feasible, in order to establish that psychological techniques were assessed with an adequate degree of sensitivity. Furthermore, while most of the previous literature has focused on one scale to assess weight perception, either verbal or visual, this thesis has considered the use of two scales for examining weight perceptions (the verbal and visual). This thesis contributes to the literature by exploring factors that have not been previously examined. Likewise combining psychological, anthropometric, and sociodemographic elements, to better understand the underestimation of overweight or obese statuses, is a unique approach as implemented in the three studies included in this thesis. On the other hand, some limitations should be considered when interpreting the findings of this thesis. First, in study 2 and 3 the use of self-reported weight and height in adults and children may be subjected to social desirability bias, as adults and parents of children may provide inaccurate information (height and weight) to meet the social standards. Despite the fact that objective parameters, such as height and weight are optimal, research has demonstrated that online self- documented data are authentic substitutes to those that are measured (Pursey *et al.,* 2014). Furthermore, the generalizability of study 2 and 3 are limited as both studies only included UK participants and therefore cannot be assumed to apply in other contexts. The use of a cross-sectional design, in study 2 and 3, limits the ability to draw causal conclusions. Notwithstanding these limitations, the use of mixed method systematic review and including more parties (children, parents and healthcare professionals) has enabled us to understand a fuller picture of these phenomena.

5.6 Recommendations for future research

Future research might apply qualitative methods to explore the factors associated with overweight underestimation. Open -ended questions may allow for a deeper understanding of

the issue, since an interpretive approach to an investigation of this nature could prove to yield effective results. Future research should certainly further test whether parental and adult preferences of larger body size is associated with underestimation of overweight status. Although study 1 sheds light on healthcare professionals' perceptions, the lack of a statistical examination hinders the strength of the evidence, future research is needed on this initial findings. Additionally the results of this thesis suggests that further studies are necessary for evaluating ways to enhance communication with healthcare providers and to diminish weight stigma as a worthwhile endeavor. As demonstrated in study 2 and 3, negative emotions linked with a diagnosis of being overweight or obese can influence precise weight status recognition and interaction with a medical specialist. Thus, additional research should investigate parents' feelings when they receive the news that their child has a weight issue, especially when using the NCMP together with the consequences of this message, including the factors linked to the difficulties associated with discussing weight. Study 1, 2 and 3 indicate that varying approaches are necessary in order to diminish the possibly negative impact of self-assessed excess weight. Additional studies should appraise likely diversity through the evaluation of cultural understandings of how a healthy BMI is defined. Further ways to decrease stigma may mean that the recognition of being overweight is not a negative phenomenon. Puhl and Brownell (2003) propose the psychosocial derivation of prejudice should be comprehended in order to diminish public censure. Research on this topic has implied that ascriptions are of value in decreasing stigma. Additional qualitative work on the cultural beliefs of adult individuals, and the parental appraisal of a child's weight, is required to offer a more complete view of this concept. A greater focus on the differences between male and female caregivers in assessing their child weight could suggest ways of redressing the negative impacts of this phenomenon. Furthermore, studies evaluating the links between body weight norms and the

underassessment of overweight within broader populations could also be important. Study 2 and 3 are relatively small experimental studies and, as such should be interpreted with caution. Therefore, it is recommended that further studies, with larger sample sizes and other contexts with diverse ethnicities, should be done to confirm and expand on these findings. Taken together, the work described in this thesis supports the recommendations future obesity - related interventions should consider the important differences between clinical definitions and lay perceptions of obesity.

5.7 Conclusion

This thesis set out to explore the factors associated with adult personal and parental underestimation of overweight status. The findings have confirmed that such underestimation of overweight status is pervasive and is associated with sociodemographic, anthropometric, and psychological, cognitive factors, as well as research methods.

Underestimation of child's overweight has been generally associated with children's gender, age, BMI, parental BMI, ethnicity and educational level. Visual scales as an assessment tool for overweight and obesity were found to be more precise than verbal rankings in recognising the degree of excess weight in a child.

Study 2 showed that underestimation of weight status is very common among people with higher weight. Underestimation of self-perceived weight was associated with age, gender, educational level, current BMI and negative emotions associated with obesity diagnosis.

The results of study 3 demonstrate that a wide variety of factors are associated with adult underestimation of child overweight status. This includes gender and age of the child, with male, and younger, children more likely to be underestimated. Male caregivers are more likely to underestimate weight as are children and caregivers who have been exposed to obesity.

Elucidating the reasons for overweight underestimation may be an essential part of combattingthe

problem of obesity. Health practitioners must be conscious of the need for instilling a heightened cognizance of the correct, and objective, criteria for effective weight estimation. While such an approach is essential, it must be applied in a way that is sensitive to the impact of social censure, images and an under-appreciation of the etiology underlying obesity.

Finally, for an effective delivery of weight management strategies, as well as weight awareness and estimation, it is imperative to have policies introduced by Public Health experts and governments that enlighten people across various social classes and identify the causal aspects related to their dietary and consequent estimation of body size.

Cultural, economic and political factors all have a significant impact on the quantity and quality of food consumed and on body weight regulation. The work presented in this thesis highlights the major factors associated with underestimation of weight that need to be addressed to better promote of healthy weight management.

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Appendix A

Participants Information sheet for study 2

Who is carrying out this study?

This research is being conducted at the University of Nottingham.

Leading the study are:

Abrar Alshahrani, (PhD student) Abrar.Alshahrani@nottingham.ac.uk

Judy Swift (Associate Professor), 0115 951 6105, judy.swift@nottingham.ac.uk, c/o Division of Food, Nutrition and Dietetics, University of Nottingham, Sutton Bonington Campus, Leicestershire, LR12 5RD.

Bodyweight evaluations

We would like to invite you to participate in this original research project being carried out by the University of Nottingham. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Before you decide whether you want to take part, it is important to understand why the research is being done and what your participation will involve. Please read the following information carefully and discuss it with others if you wish. The researcher's details are provided at the end of the information sheet if you would like to get in touch to discuss the study further.

What is the study about?

We are interested in how people evaluate their own: do they think that they are on a health

weight or perhaps overweight? We intend to investigate whether there are particular factors that influence these evaluations. We are particularly interested in whether factors such as previous experiences or other people's attitudes cause people to under- or over-estimate their own.

What will I have to do?

The study will start in [confirm date when approval is obtained and the contract with SurveyMonkey arranged]. If you would like to take part, you will need to tick the consent box at the end of this form – you do need to be 18 years or older. You will then be asked to complete a few questions about yourself, your beliefs and experiences, and how you evaluate your bodyweight. If you would like help completing the questionnaire or have any questions about the study, please contact Dr Judy Anne Swift (details later in this document).

What are the benefits of participating in the study?

There are no direct benefits for you if you take part in this study. However, by helping us with this work we will learn more about how people make evaluations about their bodyweight and ultimately how we can best support those who misperceive.

Are there any foreseeable risks to me if I participate in the research?

There are no disadvantages or risks if you take part in this study beyond those you would normally encounter at home. The questionnaire will take [confirm once up-loaded but expect it to be 10-15 minutes] of your time to complete. If you experience any problems with the questionnaire, please contact Jo Pearce via the telephone number or email address at the end of this information sheet.

Are there any costs or inducements to taking part in the research?

There are no costs or inducements associated with taking part in this study.

Is participation voluntary? What should I do if I do/do not want to participate?

Participation in this study is voluntary. If you would like to take part, just click the button to indicate that you consent and you will be taken through to the survey. If you do not want to take part, do not consent to do so. You do not have to provide a reason for not completing the questionnaire.

What happens to the collected information?

All the information that you provide will be treated confidentially. Once data collection has been completed, we will give your questionnaire an ID number that we will use instead of your name so that no one will be able to identify you. Only researchers from the University of Nottingham will see the data and data will be stored electronically, adhering to the university's data protection guidelines. Any information that may identify you (e.g. name, email address, phone number) will be permanently deleted from the dataset. N.B. Anonymity will not be guaranteed if you disclose any illegal activities or if there is disclosure or evidence of significant harm, abuse, neglect or danger to yourself or others.

You will be able to withdraw from the data from the study if you stop completing at any point. However, if you complete the study and submit your answers, we will be unable to remove you information from the dataset as it is anonymous and we will have no way of identifying you.

What are the research outputs?

Data will be used by the researcher. A report will be generated for you to access and we hope

to publish the findings of the survey in an academic journal. Neither you nor your baby will be identifiable from any of the research outputs.

What other sorts of people are being asked to take part, and how are they being identified/selected?

We would like to reach ~ 2000 people to ensure we have a dataset that is sufficiently large and diverse in order to conduct the necessary statistical tests to answer our research questions.

Privacy information for Research Participants

For information about the University's obligations with respect to your data, who you can get in touch with and your rights as a data subject, please visit: https://www.nottingham.ac.uk/utilities/privacy.aspx.

Why we collect your personal data

We collect personal data under the terms of the University's Royal Charter in our capacity as a teaching and research body to advance education and learning. Specific purposes for data collection on this occasion are for 1 publication in an academic journal.

Legal basis for processing your personal data under GDPR

The legal basis for processing your personal data on this occasion is Article 6(1a) consent of the data subject

How long we keep your data

The University may store your data for up to 25 years and for a period of no less than 7 years after the research project finishes. The researchers who gathered or processed the data may also store the data indefinitely and reuse it in future research. Measures to safeguard your stored data include anonymization of the data once both baseline and follow up data have been collected.

Who we share your data with

Extracts of your data may be disclosed in published works that are posted online for use by the scientific community. Your data may also be stored indefinitely on external data repositories (e.g., the UK Data Archive) and be further processed for archiving purposes in the public interest, or for historical, scientific or statistical purposes. It may also move with the researcher who collected your data to another institution in the future.

Contact details

Researchers: Judy Swift (Associate Professor), 0115 951 6105, judy.swift@nottingham.ac.uk, c/o Division of Food, Nutrition and Dietetics, University of Nottingham, Sutton Bonington Campus, Leicestershire, LR12 5RD.

Abrar Alshahrani, (PhD student) Abrar.Alshahrani@nottingham.ac.uk

Complaint procedure

If you wish to discuss the way in which the research is being conducted or have any concerns about this research, then in the first instance please contact Judy Swift.

If this does not resolve the matter to your satisfaction then please contact the School of Bioscience's Research Ethics Officer, Dr Kate Millar (tel. 0115 951 6303, email Kate.Millar@nottingham.ac.uk or write to address Kate Millar, Division of Nutritional Sciences, University of Nottingham, Sutton Bonington Campus, Leicestershire, LR12 5RD.

Concerns about Food Choices:

If you have any questions or concerns about your bodyweight or diet, please contact your General Practitioner. Further information about healthy behaviours related to food choices can be accessed via the NHS LiveWell pages at www.nhs.uk

Appendix B

Survey for Study 2

1. What is your age?
   - ☐ 18 – 24 years
   - ☐ 25 – 44 years
   - ☐ 45 – 74 years
   - ☐ 75+ years

2. What is your gender? ☐ Male ☐ Female

3. Which of the following best describes your ethnic origin?

White	Black and Black British
[ ] British	[ ] Black Caribbean
[ ] Irish	[ ] Black African
[ ] Other White _____	[ ] Other Black_____

Mixed
[ ] White and Black Caribbean
[ ] White and Black African
[ ] White and Asian
[ ] Other mixed
_____

Asian and Asian British
[ ] Indian
[ ] Pakistani
[ ] Bangladeshi
[ ] Gujarati
[ ] Tamil
[ ] Other Asian_____

Chinese and Other Ethnic Groups
[ ] Chinese
[ ] Korean

[ ] Other ethnic group, give details
_____

4. What is the highest level of education you have completed?

☐ No formal qualifications
☐ GCSE or equivalent
☐ A level or equivalent
☐ Undergraduate degree or equivalent
☐ Postgraduate degree or equivalent

5. In general, would you say your health is:

☐ Excellent
☐ Very good
☐ Fair
☐ Poor

6. How would you describe your weight to your GP?

7. How much do you weigh?

☐ kg or ☐ st ☐ lbs

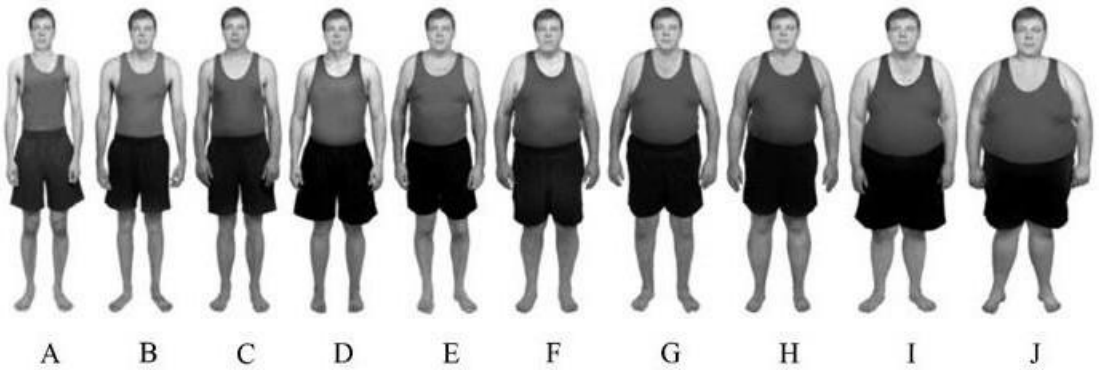
8. What is your height?

☐ cm or ☐ ft ☐ inches

9. Which Figure best describes your present body shape/size?

1. A 3. C 5. E 7. G 9. I

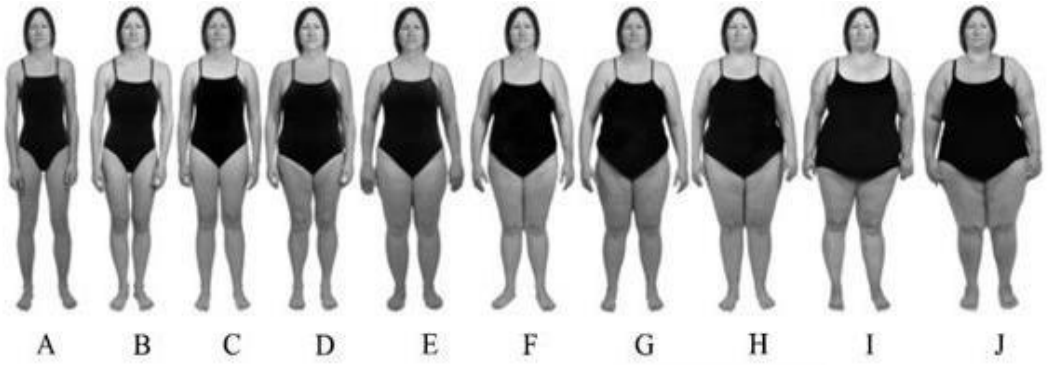
2. B 4. D 6. F 8. H 10. J



10. Which Figure best describes your present body shape/size?

1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J



11. According to these widely used medical criteria, would you say that (at the moment) your weight can best be described as:

- ☐ Underweight
- ☐ Healthy weight
- ☐ Overweight
- ☐ Obese

12. Have you ever been had your weight measured by a healthcare professional, such as a GP or practice nurse?

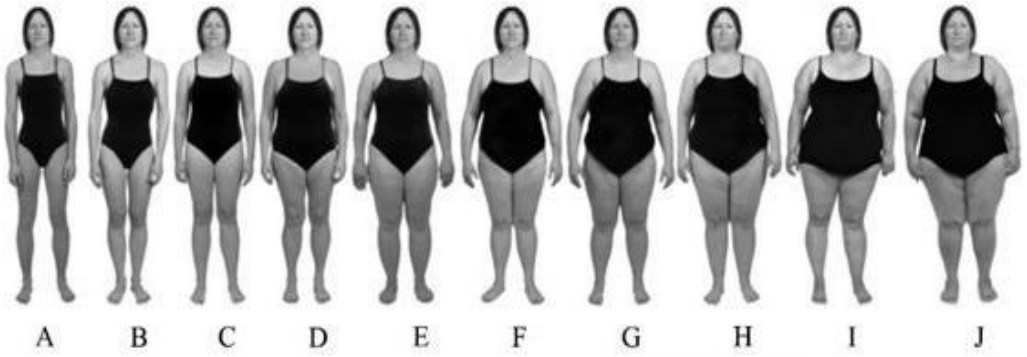
- ☐ No
- ☐ Yes, they said I was underweight
- ☐ Yes, they said I was a healthy weight
- ☐ Yes, they said I was overweight
- ☐ Yes, they said I was obese
- ☐ Yes, but they didn't categorise my weight.

13. For men, please select all those body shape/size that you normally see in everyday life?



1. A 3. C 5. E 7. G 9. I
2. B 4. D 6. F 8. H 10. J

14. For women, please select all those body shape/size that you normally see in everyday life?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

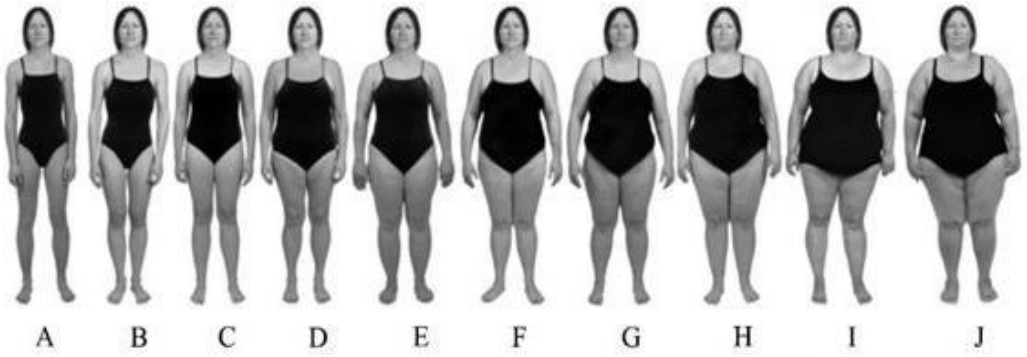
15. For men, which Figure best describes an average body shape/size for men your age?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

16. For women, which Figure best describes an average body shape/size for women your age?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

Below is a list of situations that some people encounter because of their weight. Indicate whether, and how often, each of these situations happens to you

1. Physical barriers.

Never Less than monthly Monthly (3) Weekly Daily or almost daily

2. Nasty comments from others.

Never Less than monthly Month Weekly Daily or almost daily

3. Nasty comments from family.

Never Less than monthly Month Weekly Daily or almost daily

4. Inappropriate comments from doctors

Never Less than monthly Monthly Weekly Daily or almost daily

5. Loved ones embarrassed by your size.

Never Less than monthly Monthly Weekly Daily or almost daily

6. Others making negative assumptions about you.

Never Less than monthly Monthly Weekly Daily or almost daily

7. Being stared at

Never Less than monthly Monthly Weekly Daily or almost daily

8. Comments from children.

Never Less than monthly Monthly Weekly Daily or almost daily

9. Being avoided, excluded or ignored.

Never Less than monthly Monthly Weekly Daily or almost daily

10. Job discrimination.

Never Less than monthly Monthly Weekly Daily or almost daily

11. Being physically attacked

Never Less than monthly Monthly Weekly Daily or almost

daily

Please select the answer which best describes how you feel.

Because of my weight, I feel that I am just as competent as anyone	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I am less attractive than most other people because of my weight	☐1	☐2	☐3	☐4	☐5	☐6	☐7

I feel anxious about my weight because of what people might think of me	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I wish I could drastically change my weight	☐1	☐2	☐3	☐4	☐5	☐6	☐7
Whenever I think a lot about my weight, I feel depressed	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I hate myself for my weight	☐1	☐2	☐3	☐4	☐5	☐6	☐7
My weight is a major way that I judge my value as a person.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I don't feel that I deserve to have a really fulfilling social life, because of my weight	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I am OK being the weight that I am	☐1	☐2	☐3	☐4	☐5	☐6	☐7
Because of my weight, I don't feel like my true self	☐1	☐2	☐3	☐4	☐5	☐6	☐7
Because of my weight, I don't understand how anyone attractive would want to date me	☐1	☐2	☐3	☐4	☐5	☐6	☐7

Please read the following statements and select the answer, which best describes how you feel.

I would do anything to avoid being obese	☐1	☐2	☐3	☐4	☐5
My biggest fear is of becoming obese.	☐1	☐2	☐3	☐4	☐5
Becoming obese would be the worst thing that could happen to me.	☐1	☐2	☐3	☐4	☐5
If I become obese, I would be comfortable with my body.	☐1	☐2	☐3	☐4	☐5
Obesity is not something to be afraid of.	☐1	☐2	☐3	☐4	☐5

There is nothing fearful about becoming obese	☐1	☐2	☐3	☐4	☐5
If became obese, I could not live the life I want to.	☐1	☐2	☐3	☐4	☐5
I would be ashamed of my body if I was obese.	☐1	☐2	☐3	☐4	☐5
It is ok if I became obese.	☐1	☐2	☐3	☐4	☐5
I could accept myself if I am obese.	☐1	☐2	☐3	☐4	☐5

Appendix C

Participant's information sheet for study 3

Who is carrying out this study?

This research is being conducted at the University of Nottingham.
Leading the study are:
PhD nutritional science student /Abrar Fahad Alshahrani
Principle supervisor/ Prof Andrew Salter
Second supervisor/ Dr Amanda Avery

Bodyweight evaluations
We would like to invite you to participate in this original research project being carried out by the University of Nottingham. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Before you decide whether you want to take part, it is important to understand why the research is being done and what your participation will involve. Please read the following information carefully and discuss it with others if you wish. The researcher's details are provided at the end of the information sheet if you would like to get in touch to discuss the study further.

What is the study about?
We are interested in how people evaluate their own bodyweight or their child's weight: do they think that they are a health weight or perhaps overweight? What are their thoughts about their children's weight and shape? We intend to investigate whether there are particular factors that influence these evaluations. We are particularly interested in whether factors such as previous experiences or other people's attitudes cause people to under- or over-estimate their own and their children's weight status
What would I have to do?
You are invited to complete this questionnaire to tell us about your weight and experiences relating to your bodyweight. This includes asking you about your/child current bodyweight, how you feel about it, and how you might feel if your child's bodyweight were to change.

What are the benefits of participating?
There are no direct benefits for you if you take part in this study. The main benefit to participating in this study is that you will help us understand more about British people's views and perceptions to bodyweight. The results of the study may be published in journals and newsletters read by healthcare professionals such as doctors, nurses, and dietitians. We would also send you a summary of the main study findings upon request (please contact the study team).

Are there any foreseeable risks to me if I participate in the research?
There are no disadvantages or risks if you take part in this study beyond those you would normally encounter at home. The questionnaire will take [confirm once up-loaded but expect it to be 10-15 minutes] of your time to complete. If you experience any problems with the questionnaire, please contact Prof Andrew Salter via the telephone number or email address

at the end of this information sheet.

Are there any costs or inducements to taking part in the research?
There are no costs or inducements associated with taking part in this study.

Is participation voluntary? What should I do if I do/do not want to participate?
Participation in this study is voluntary. If you would like to take part, just click the button to indicate that you consent and you will be taken through to the survey. If you do not want to take part, do not consent to do so. You do not have to provide a reason for not completing the questionnaire.

What happens to the collected information?
All the information that you provide will be stored securely and treated confidentially in accordance with the University of Nottingham GDPR policy (further details of which can be found at: https://www.nottingham.ac.uk/governance/documents/data-protection-policy-approved.pdf). Once data collection has been completed, we will give your questionnaire an ID number that we will use instead of your name so that no one will be able to identify you. Only researchers from the University of Nottingham will see the data and data will be stored electronically, adhering to the university's data protection guidelines. Any information that may identify you (e.g. name, email address, phone number) will be permanently deleted from the dataset. N.B. Anonymity will not be guaranteed if you disclose any illegal activities or if there is disclosure or evidence of significant harm, abuse, neglect or danger to yourself or others.

You will be able to withdraw from the data from the study if you stop completing at any point. However, if you complete the study and submit your answers, we will be unable to remove you information from the dataset as it is anonymous and we will have no way of identifying you.

What are the research outputs?
Data will be used by the researcher. A report will be generated for you to access and we hope to publish the findings of the survey in an academic journal. Neither you nor your baby will be identifiable from any of the research outputs.

What other sorts of people are being asked to take part, and how are they being identified/selected?
We would like to reach ~ 2000 people to ensure we have a dataset that is sufficiently large and diverse in order to conduct the necessary statistical tests to answer our research questions.

Privacy information for Research Participants?
For information about the University's obligations with respect to your data, who you can get in touch with and your rights as a data subject, please visit:
https://www.nottingham.ac.uk/utilities/privacy.aspx.

Why we collect your personal data?
We collect personal data under the terms of the University's Royal Charter in our capacity as a teaching and research body to advance education and learning. Specific purposes for data collection on this occasion are for 1 publication in an academic journal.

Legal basis for processing your personal data under GDPR
The legal basis for processing your personal data on this occasion is Article 6(1a) consent of the data subject

How long we keep your data?
The University may store your data for up to 25 years and for a period of no less than 7 years after the research project finishes. The researchers who gathered or processed the data may also store the data indefinitely and reuse it in future research. Measures to safeguard your stored data include anonymization of the data once both baseline and follow up data have been collected.

Who we share your data with?
Extracts of your data may be disclosed in published works that are posted online for use by the scientific community. Your data may also be stored indefinitely on external data repositories (e.g., the UK Data Archive) and be further processed for archiving purposes in the public interest, or for historical, scientific or statistical purposes. It may also move with the researcher who collected your data to another institution in the future.

Thank you for considering participation in this study. Please do get in contact if we can provide any further information.

Contact details:
Abrar Alshahrani
PhD student in Nutritional sciences
Abrar.Alshahrani@nottingham.ac.uk

Prof Andrew Salter

Professor of Nutritional Biochemistry

University of Nottingham
andrew.salter@nottingham.ac.uk
0115 951 6122

Concerns:
If you remain unhappy and wish to complain formally, you should then contact the School of Biosciences Research Ethics Officer, Dr Kate Millar, on 0115 951 6303, or Kate.Millar@nottingham.ac.uk

Appendix D

Survey for study 3

1. What is your age?
   - ☐ 18 – 24 years
   - ☐ 25 – 44 years
   - ☐ 45 – 74 years
   - ☐ 75+ years

2. What is your gender? ☐ Male ☐ Female

3. Which of the following best describes your ethnic origin?

White
[ ] British
[ ] Irish
[ ] Other White _____

Black and Black British
[ ] Black Caribbean
[ ] Black African
[ ] Other Black_____

Mixed
[ ] White and Black Caribbean
[ ] White and Black African
[ ] White and Asian
[ ] Other mixed
_____

Asian and Asian British
[ ] Indian
[ ] Pakistani
[ ] Bangladeshi
[ ] Gujarati
[ ] Tamil
[ ] Other Asian_____

Chinese and Other Ethnic Groups
[ ] Chinese
[ ] Korean

[ ] Other ethnic group, give details
_____

4. What is the highest level of education you have completed?
   - ☐ No formal qualifications
   - ☐ GCSE or equivalent
   - ☐ A level or equivalent
   - ☐ Undergraduate degree or equivalent
   - ☐ Postgraduate degree or equivalent

5. In general, would you say your health is :

Excellent

Very good

Fair

Poor

6. How much do you weigh?

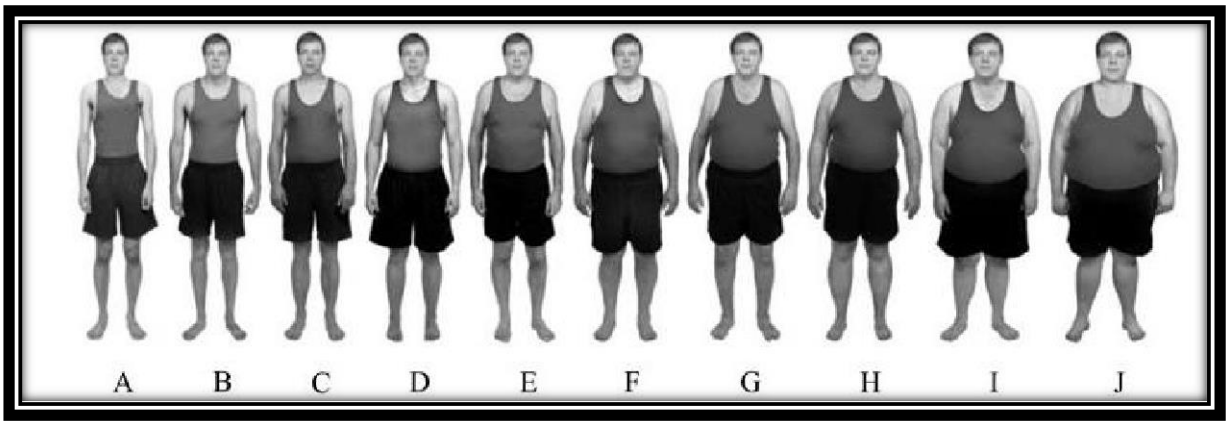
kg or st lbs I

don't know

7. What is your height?

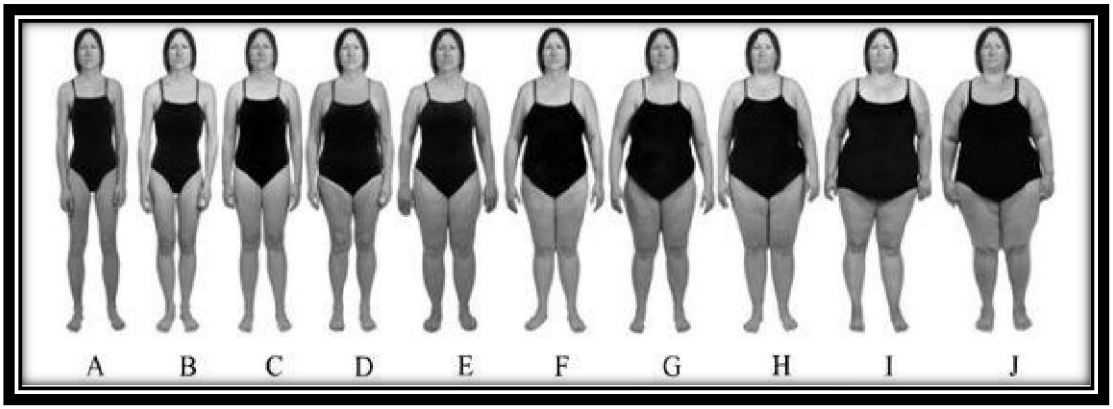
cm or ft inches I

don't know



8. Which Figure best describes your present body shape/size?

1. A 3. C 5. E 7.G 9. I
2. B 4. D 6.F 8.H 10. J



9. Which Figure best describes your present body shape/size?

1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

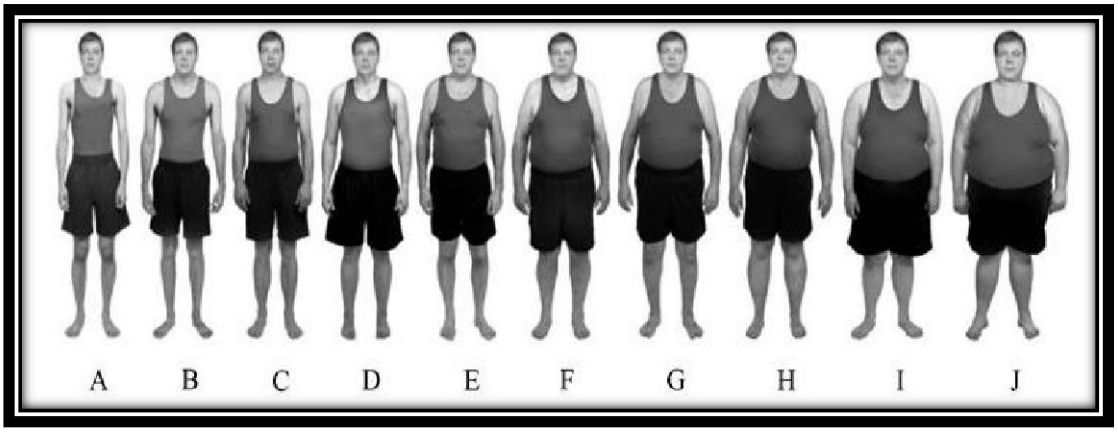
10. According to these widely used medical criteria, would you say that (at the moment) your weight can best be described as:

- ☐ Underweight
- ☐ Healthy weight
- ☐ Overweight
- ☐ Obese

11. Have you ever been had your weight measured by a healthcare professional, such as a GP or practice nurse?

- ☐ No
- ☐ Yes, they said I was underweight
- ☐ Yes, they said I was a healthy weight
- ☐ Yes, they said I was overweight
- ☐ Yes, they said I was obese
- ☐ Yes, but they didn't categorise my weight.

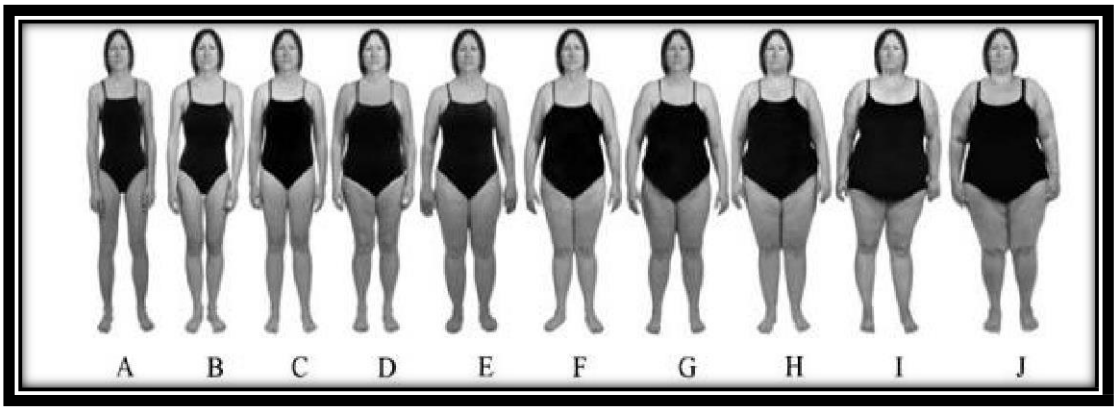
12. For men, please select all those body shape/size that you normally see in everyday life?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

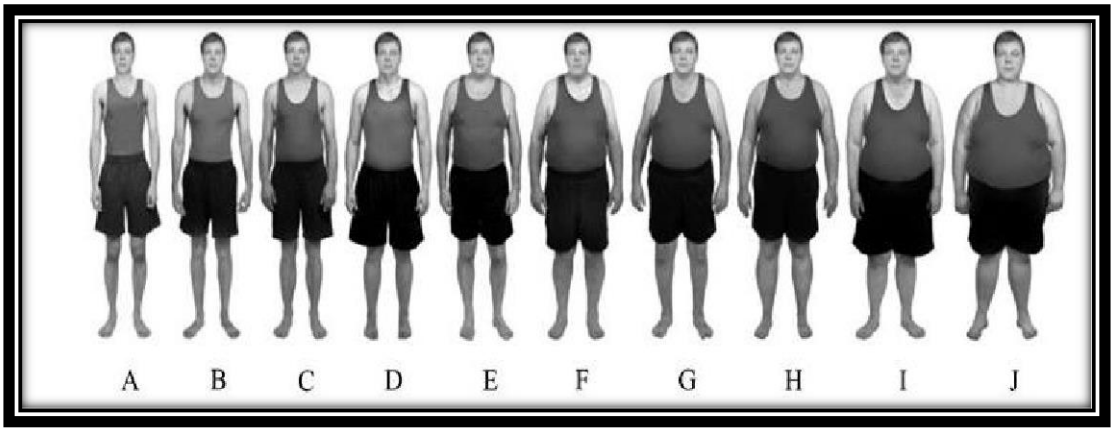
13. For women, please select all those body shape/size that you normally see in everyday life?



1. A 3. C 5. E 7. G 9. I

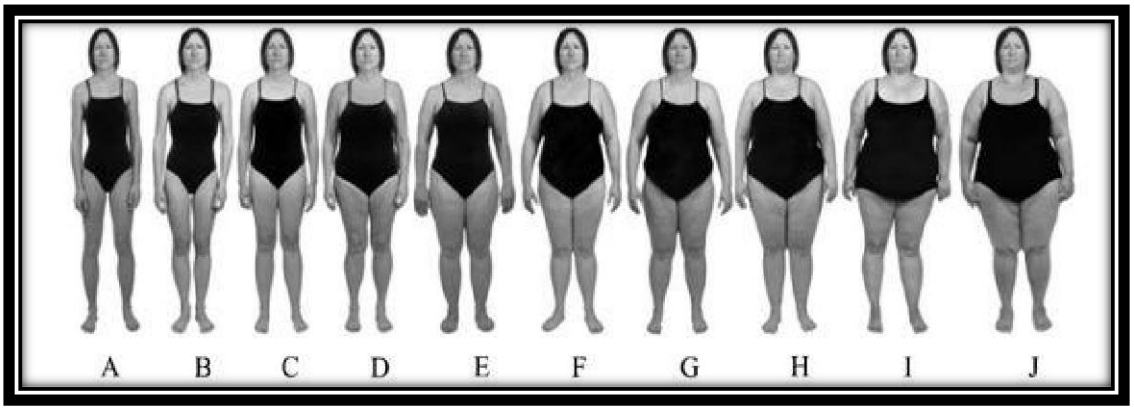
2. B 4. D 6. F 8. H 10. J

14. For men, which Figure best describes an average body shape/size for men your age?



1. A	3. C	5. E	7. G	9. I
2. B	4. D	6. F	8. H	10. J

15. For women, which Figure best describes an average body shape/size for women your age?



1. A	3. C	5. E	7. G	9. I
2. B	4. D	6. F	8. H	10. J

20. Are you a parent or grandparent of a child who is currently age 5-6?

Girls yes or no ☐ Boys Yes or No ☐

21. Would you categorise any of your children who is currently age 5-6 as (please select one child)

Overweight ☐

Obese ☐

22. How much do the selected child weigh?

☐ kg or ☐ st ☐ lbs ☐ I don't know

23. What is the height of the selected child?

☐ cm or ☐ ft ☐ inches ☐ I don't know

24. Are you a parent or grandparent of a child who is currently age 7-10?

Girls yes or no ☐ Boys yes or no ☐

25. Would you categorise any of your children who is currently age 7 -10 as (please select one child)

Overweight ☐

Obese ☐

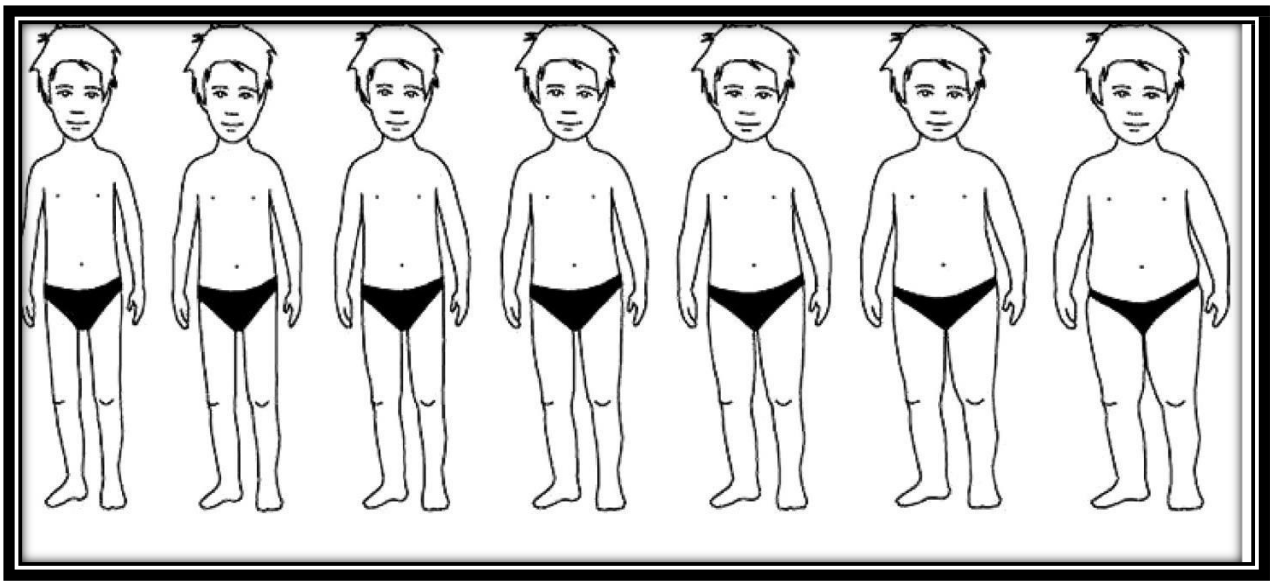
26. How much do the selected child weigh?

☐ kg or ☐ st ☐ lbs ☐ I don't know

27. What is the height of the selected child?

☐ cm or ☐ ft ☐ inches ☐ I don't know

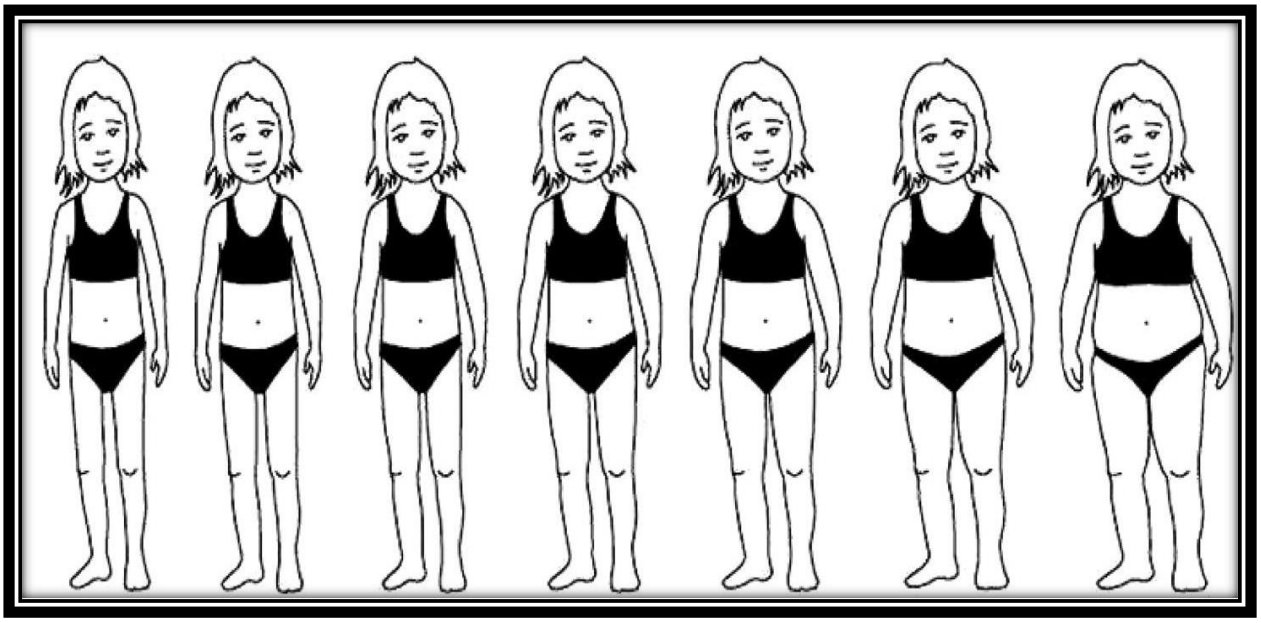
28. which Figure best represent the current body shape/size of the selected child (5-6) boy ?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

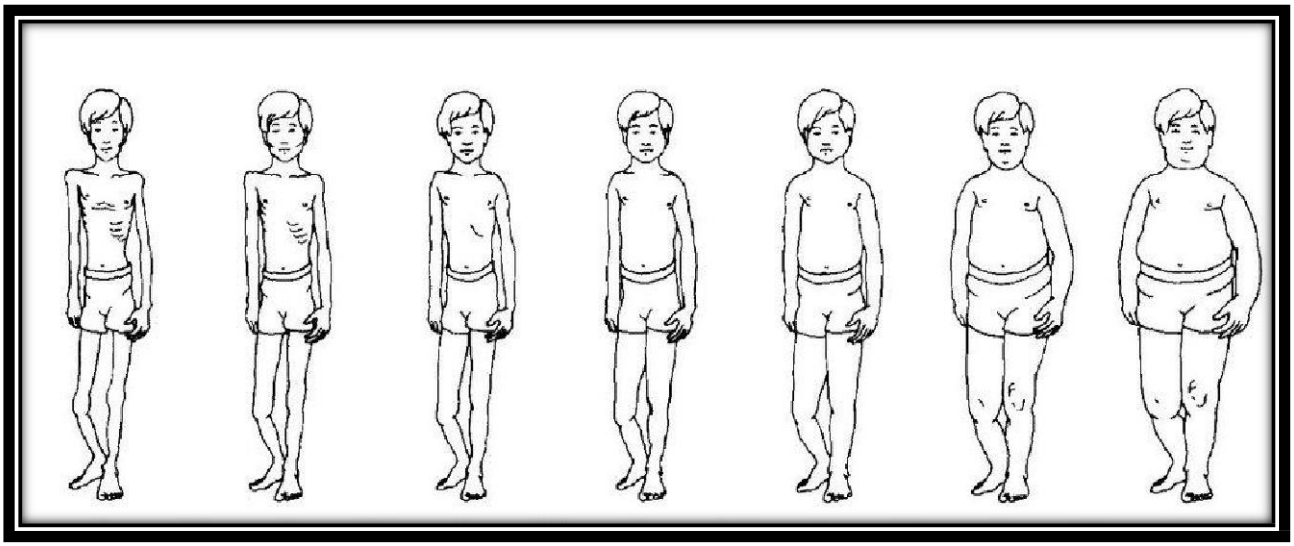
29. which Figure best represent the current body shape/size of the selected child (5-6)girl ?



1. A 3. C 5. E 7. G 9. I

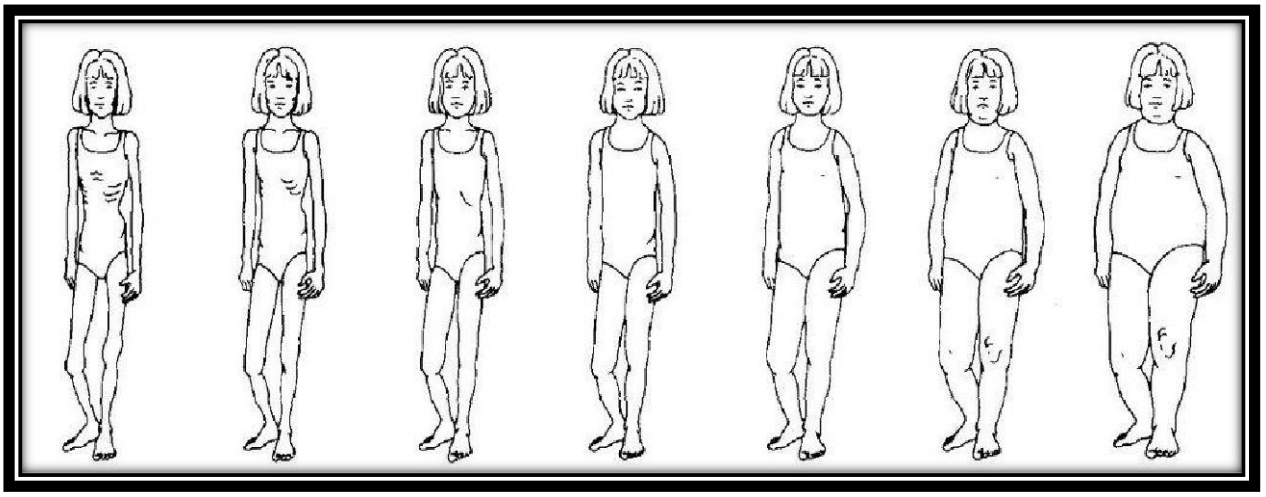
2. B 4. D 6. F 8. H 10. J

30. which Figure best represent the current body shape/size of the selected child (7-10)boy?



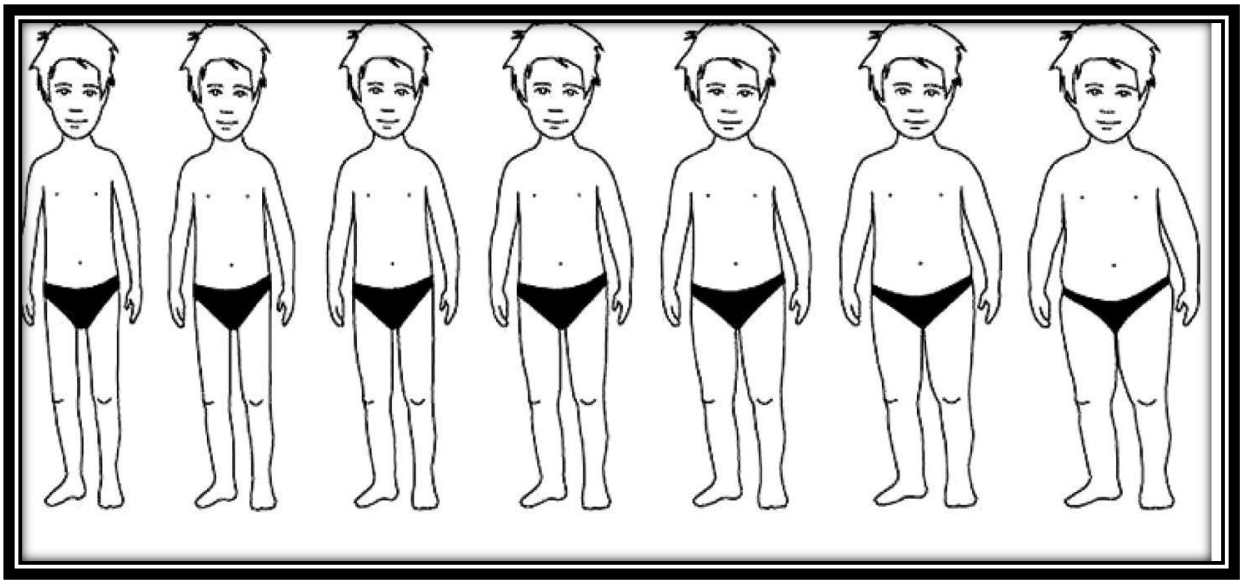
1. A	3. C	5. E	7. G	9. I
2. B	4. D	6. F	8. H	10. J

31. which Figure best represent the current body shape/size of the selected child (7-10) girl?



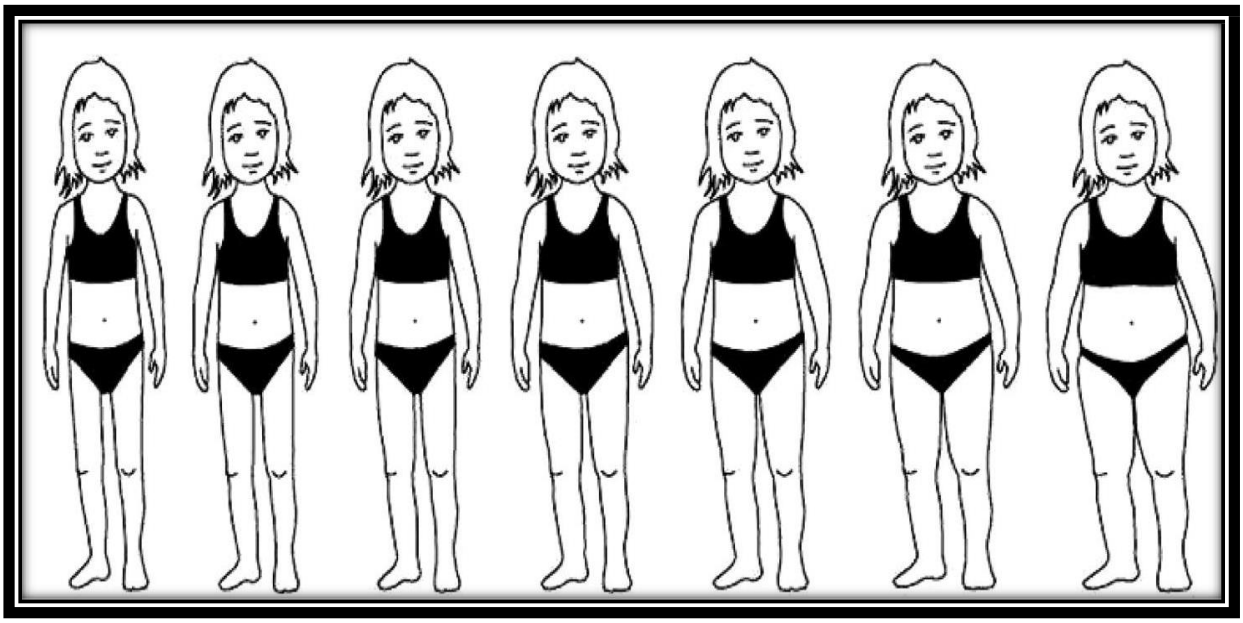
1. A	3. C	5. E	7. G	9. I
2. B	4. D	6. F	8. H	10. J

32. For parents and grandparents of boys aged 5-6years, please select all those body shape/size that you normally see in everyday life?



1. A	3. C	5. E	7. G	9. I
2. B	4. D	6. F	8. H	10. J

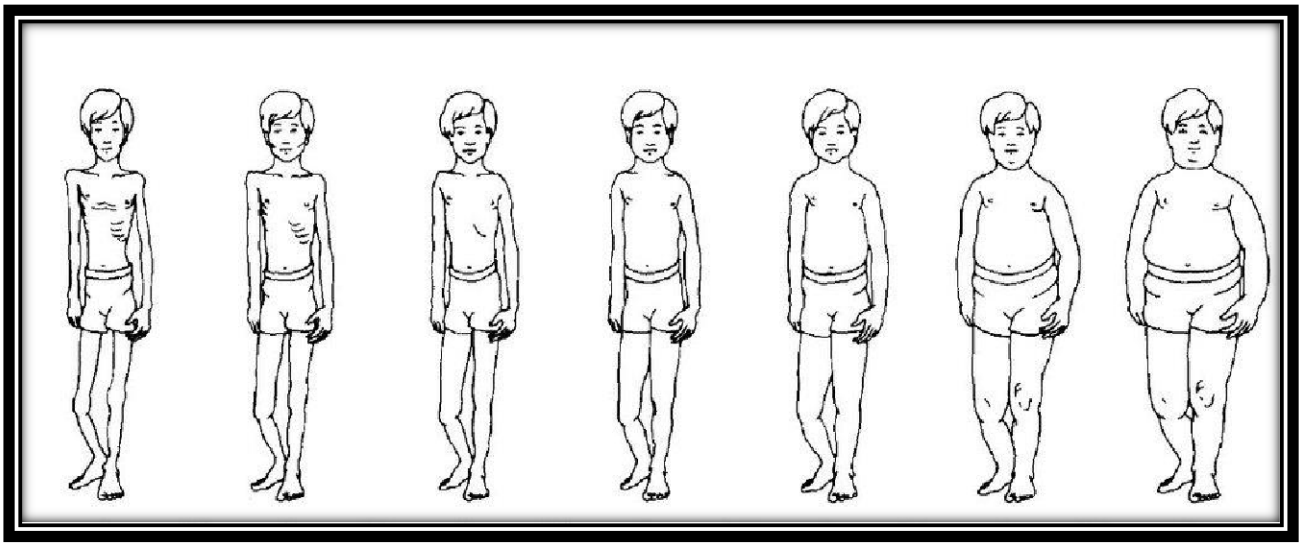
33. For parents and grandparents of girls aged 5-6, please select all those body shape/size that you normally see in everyday life?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

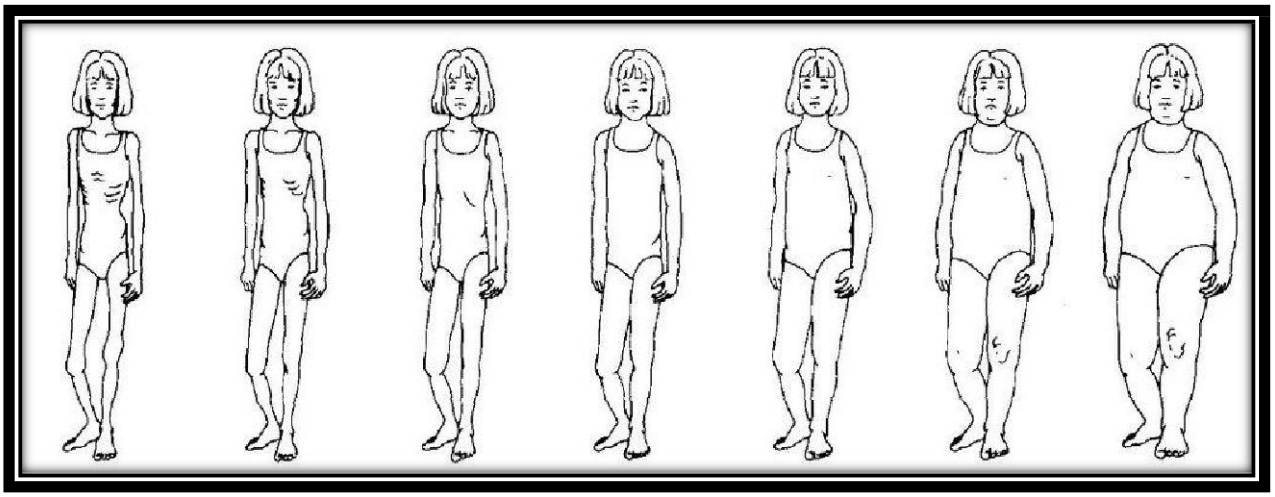
34. For parents and grandparents of boys aged 7-10 years, please select all those body shape/size that you normally see in everyday life?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

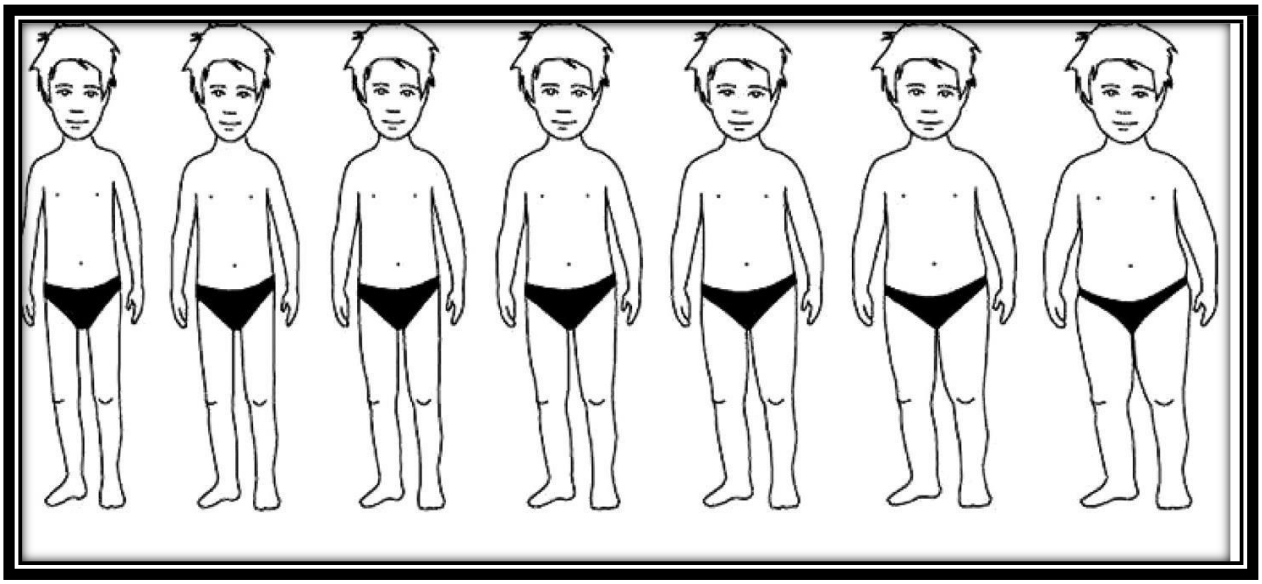
35. For parents and grandparents of girls aged 7-10, please select all those body shape/size that you normally see in everyday life?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

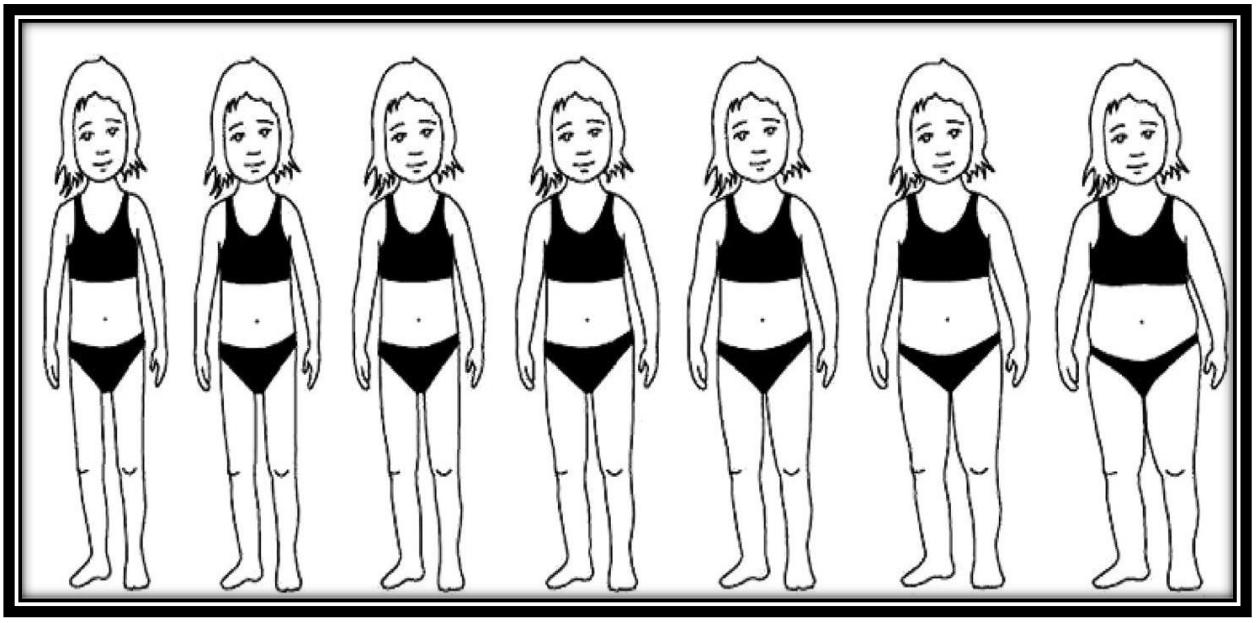
36. For parents and grandparents , which Figure best describes an average body shape/size for boys aged 5-6 years?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

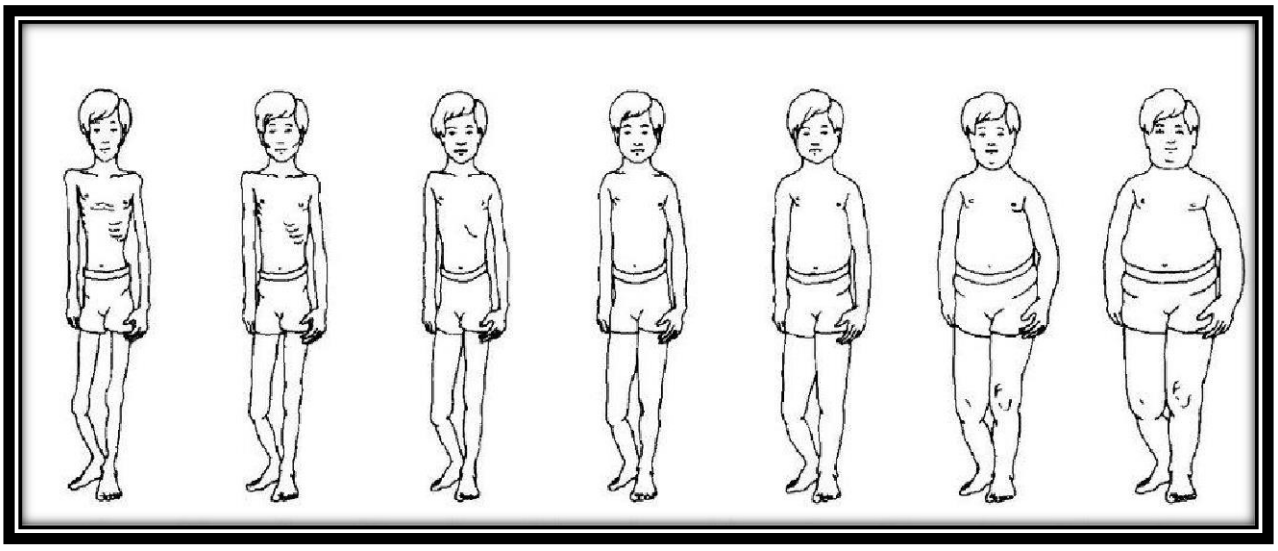
37. For parents and grandparents, Which Figure best describes an average body shape/size for girls aged 5-6 years?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

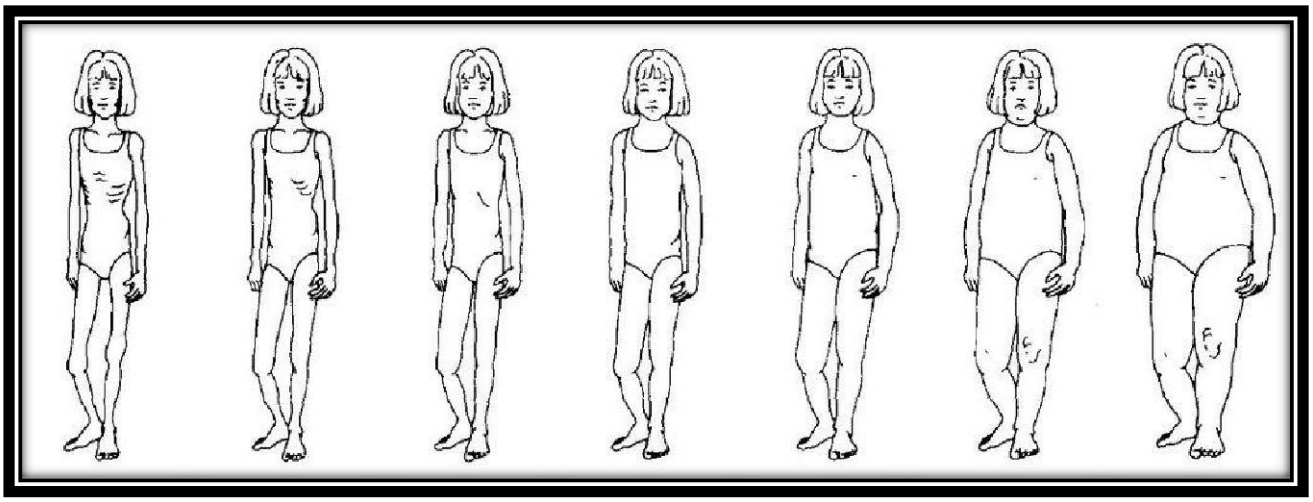
38. For parents and grandparents, which Figure best describes an average body shape/size for boys aged 7-10 years?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

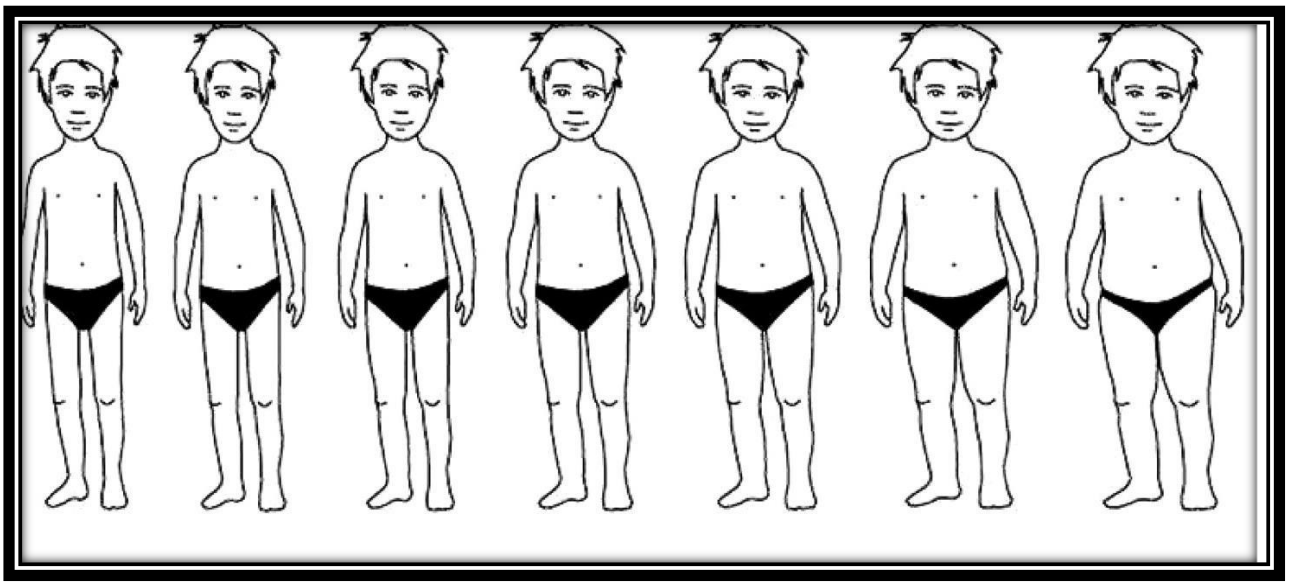
39. For parents and grandparents, which Figure best describes an average body shape/size for girls aged 7-10 years?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

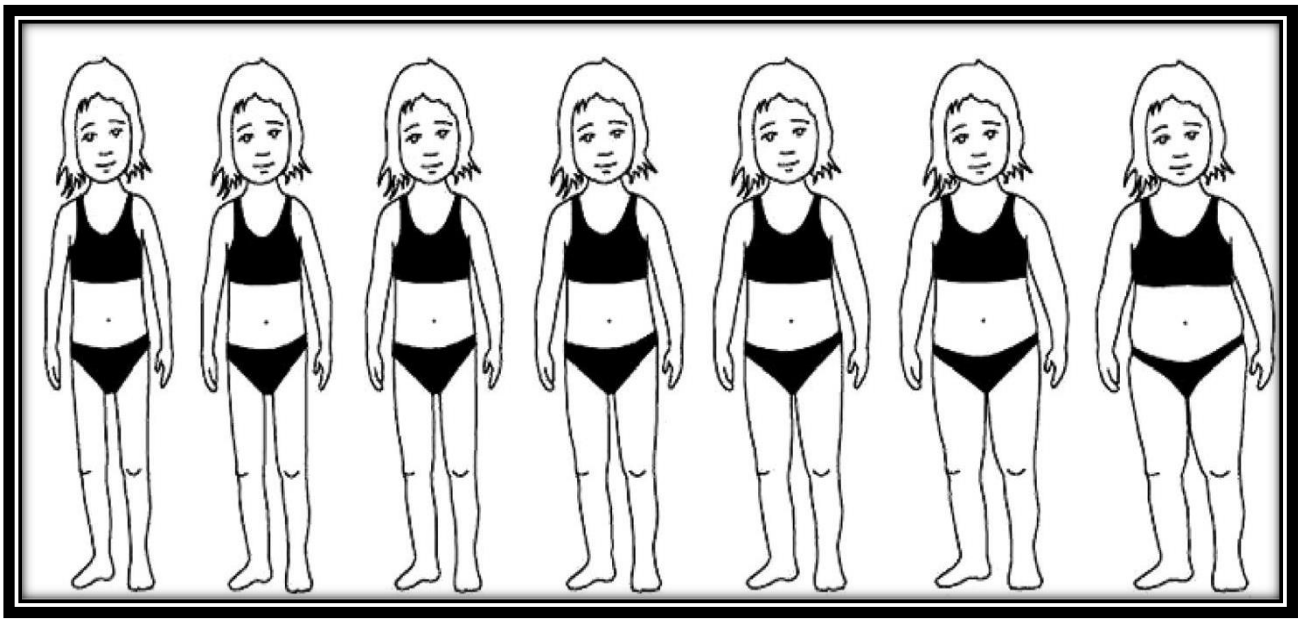
40. For parents and grandparents, which of the silhouettes do you prefer for a boy aged 5-6 years?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

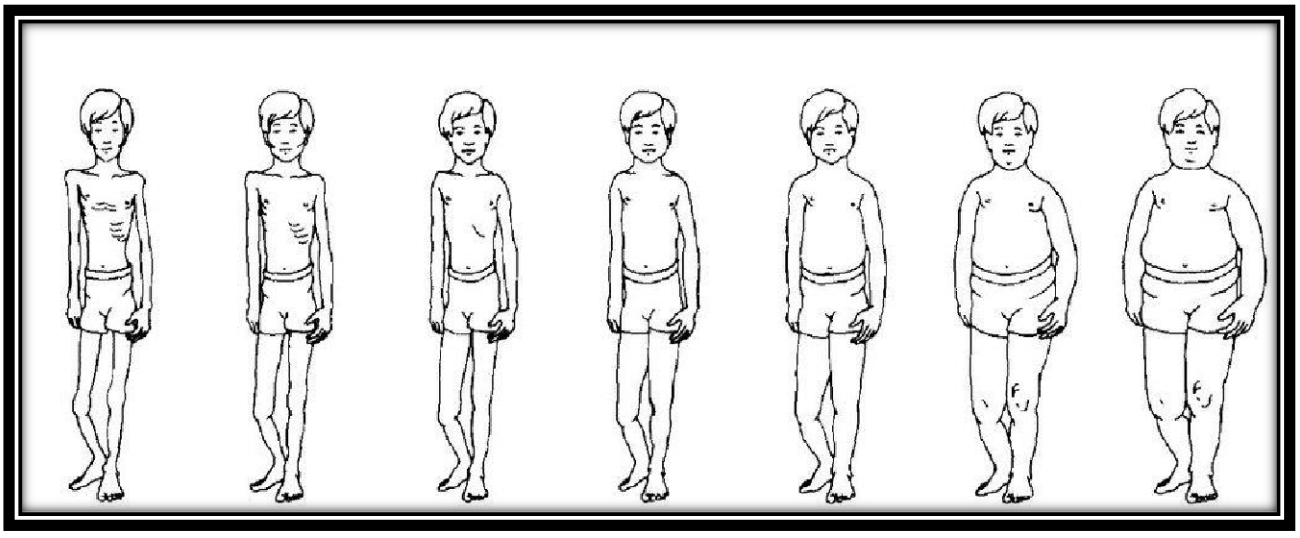
41. For parents and grandparents, which of the silhouettes do you prefer for a girl aged 5-6?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

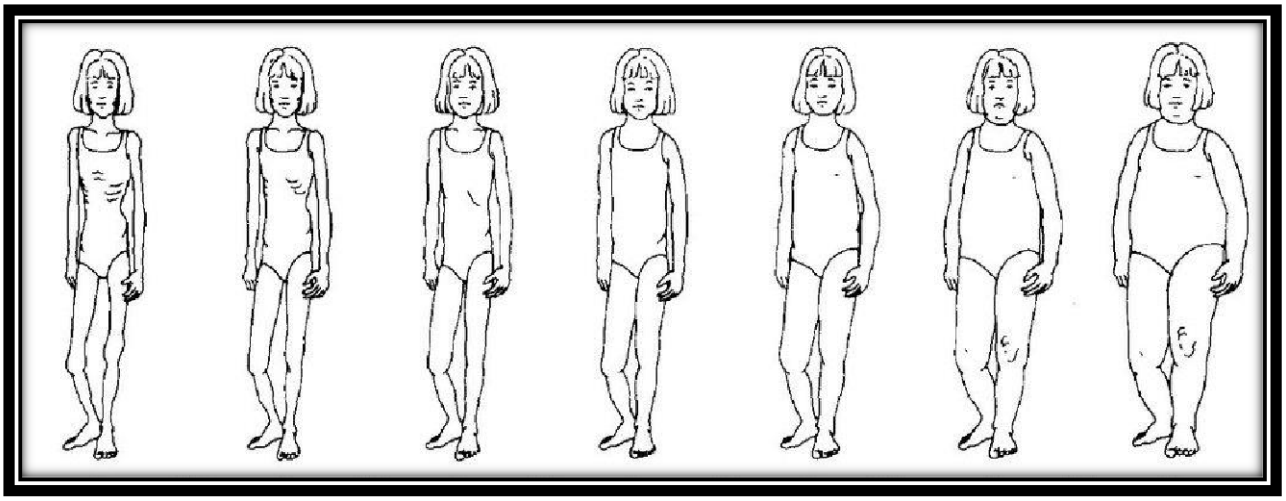
42. For parents and grandparents, which of the silhouettes do you prefer for a boy aged 7-10 years?



1. A 3. C 5. E 7. G 9. I

2. B 4. D 6. F 8. H 10. J

43. For parents and grandparents, which of the silhouettes do you prefer for a girl aged 7-10 years?



1. A	3. C	5. E	7. G	9. I
2. B	4. D	6. F	8. H	10. J

Please select the answer which best describes how you feel.

44. Because of my weight, I feel that I am just as competent as anyone	☐1	☐2	☐3	☐4	☐5	☐6	☐7
45.I am less attractive than most other people because of my weight	☐1	☐2	☐3	☐4	☐5	☐6	☐7
46. I feel anxious about my weight because of what people might think of me	☐1	☐2	☐3	☐4	☐5	☐6	☐7
47. I wish I could drastically change my weight	☐1	☐2	☐3	☐4	☐5	☐6	☐7
48. Whenever I think a lot about my weight, I feel depressed	☐1	☐2	☐3	☐4	☐5	☐6	☐7
41. I hate myself for my weight	☐1	☐2	☐3	☐4	☐5	☐6	☐7
49. My weight is a major way that I judge my value as a person.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
50. I don't feel that I deserve to have a really fulfilling social life, because of my weight	☐1	☐2	☐3	☐4	☐5	☐6	☐7
51. I am OK being the weight that I am	☐1	☐2	☐3	☐4	☐5	☐6	☐7

52. Because of my weight, I don't feel like my true self	☐1	☐2	☐3	☐4	☐5	☐6	☐7
53. Because of my weight, I don't understand how anyone attractive would want to date me	☐1	☐2	☐3	☐4	☐5	☐6	☐7

Please read the following statements and select the answer, which best describes how you feel.

54. I worry about my child becoming obese.	☐1	☐2	☐3	☐4	☐5
55. I would be proud of my child's body if he/she was obese	☐1	☐2	☐3	☐4	☐5
56. I would do anything to avoid my child being obese.	☐1	☐2	☐3	☐4	☐5
57. My biggest fear is of my child becoming obese	☐1	☐2	☐3	☐4	☐5
58. If my child become obese, he/she would be comforable with his/her body	☐1	☐2	☐3	☐4	☐5
59.There is nothing fearful about being obese	☐1	☐2	☐3	☐4	☐5
60. If my child became obese, he/she could not live the life I want it	☐1	☐2	☐3	☐4	☐5
61. t is ok if my child became obese.	☐1	☐2	☐3	☐4	☐5
62. My child could accept himself/ herself if he/she became obese.	☐1	☐2	☐3	☐4	☐5

63. Becoming obese would not affect my child confidence.	☐1	☐2	☐3	☐4	☐5