The association between Libyan parents' perception, health literacy and their children's Body Mass Index- a cross-sectional study

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Abstract

Parental awareness of their child's obesity status is a protective factor during childhood against potential weight gain, parents play a major role in the prevention and regulation of childhood obesity, in they are role models in regulating and encouraging their children's lifestyle.

Objectives To assess the parent's perception of the health status of their children, health literacy, and perhaps the correlation between the two on their primary school children's BMI in the Western region of Libya.

Methods A cross-sectional study was conducted in Libya to measure parental perceptions of childhood obesity, parental health literacy status, and BMI of their children from December 2018 to April 2019. To address the research questions, data collection methods were used in this study, including; the Arabic versions of the Health Literacy Questionnaire (HLS-EU-Q47) and the Childhood Obesity Perceptions (COP) Survey, BMI measurements were taken from the children. The sample size of this study is 1142 respondents among parents of government primary school students aged 6 to 12 years who were enrolled in West City primary schools during the study period.

Results Bivariate analysis (Two-way Analysis of variance) was applied to investigate the connection between parental perception, and children's Body Mass Index. In multivariate analysis, structural equation modeling (SEM) was used to estimate the relationship between parental

perception and children's Body Mass Index. The results shows that parents' perception and parental health literacy are significantly correlated with their children BMI.

Conclusions The findings provide a clearer understanding of the parental influences (perception of childhood obesity and, health literacy) on the BMI of their children and the obesity status of their children. However, this research may be taken as an observational study on the role of parents in Libya in addressing childhood obesity and raising their expectations of their children's BMI.

Keywords Obesity, parents' perception, health literacy, children, Body Mass Index, Libya

Introduction

Obesity is characterized as an unhealthy or excessive accumulation of fat that can affect health (1). The word "obesity" can be described as excessive fat accumulation in adipose tissues that indicates or signals a number of chronic health problems including diabetes, cancer, cardiovascular-related illness, and adverse effects on general health (2–4). Obesity is usually defined as a common method used to quantify and categorize obesity to the Body Mass Index (BMI), a measure of weight (kilograms) divided by height (meter squared) as a common tool employed to measure and categories obesity (2,5,6). Obesity is now considered a significant problem in medium and high-income countries (1). Obesity is associated with various health problems that raise the risk of divergence diseases and early mortality (7–9). The high prevalence of childhood obesity and overweight has recently imposed a serious health impact globally, especially in developed countries (10). Some of the evidence that is connected to childhood obesity is higher blood pressure (11), mental retardation (12), respiratory diseases (asthma) (13) among many. Childhood obesity can have a deep effect the physical health, mental well-being, social health, and self-esteem. Childhood obesity has been linked with multiple medical problems (14). Obesity in children is also connected to academic and psychosocial issues, potential long-term financial problems, low self-confidence, and low self-esteem (15). In addition, obese children are at risk of becoming obese adults with the long-term negative socioeconomic, psychological, and physical impacts faced by obese adults (16). Based on the World Obesity Clinical Health Care guidelines, it was statistically estimated in 2004 that 2–3% of children aged 5–17 years globally were obese (17). Prevalence rates vary greatly between different countries and regions, ranging from 5% in Africa and parts of Asia to about 20% in Europe, while more than 30% in some Middle East countries and the Americas (18). In the United States, the proportion of children aged 6–11 years who are obese grew

from 7% in 1980 to 18% in 2012. Similarly, the percentage of adolescents aged 12–19 years who are obese in the United States grew from 5% to 21% during the same period (19).

Obesity has risen to striking levels in Arab countries, with the incidence of obesity ranging from 7 % to 45% in school children aged 14 to 18 years (20). In 2005, 12% of children aged 5 were obese in Saudi Arabia, with obesity levels increasing to 27% by the age of 10, 39% of 10-year-old boys were obese in Kuwait in 2011 (21). In addition, in Egypt, the prevalence of childhood obesity among children aged from 6 to 12 years was 13.5% in 2013 (22). In the last 30 years, the prevalence of obesity in Libya has significantly increased (23). The prevalence has risen from 16.2% in 1995 (24) to 26 % in 2007 (21) to 34% in 2014 (25).

Perception is the process of being aware of sensory information or understanding it (Seligman, 2009). The understanding of childhood obesity by parents is the way the parents obtain, collect, take control, apprehend the mind or senses, and actively understand, recognizes, and reacts to the body weight status of their children (26). The understanding of childhood obesity by parent is an important factor influencing dietary and lifestyle habits concerning the wellbeing of their children. Research has shown that almost 75% of parents fail to consider their obese child as being obese and are unable to perceive the weight status of their child (27). The view of parents plays a major role in the prevention and regulation of childhood obesity, in which they are role models in regulating and encouraging their children's lifestyle. Studies have shown that parental awareness of their child's obesity status is a protective factor during childhood against potential weight gain (28). The perceptions of childhood obesity by parents as a modifiable factor can therefore be a very important factor to consider in efforts to reduce the burden of childhood obesity, especially among parents with low health literacy (29). The most important non-modifiable risk factors for childhood obesity are factors such as genetics, family background, and age (30), while modifiable risk factors include, less physical activity, sedentary lifestyle, unhealthy diet, social factors, environmental factors, and sleep deprivation (31). The awareness of parents about risk factors of childhood obesity is integral to childhood obesity management and prevention as parents play a vital role model in encouraging and establishing healthy habits in their children, involving parents will enable them to identify the causes of childhood obesity, so reformist actions can be started (32).

In recent years, health literacy has become an important health component of health policy and health promotion (33). The World Health Organization has described it as "the features and social resources required for people to access, understand, and use the information to make health

decisions''. The ability to communicate, assert, and enact these decisions is included in health literacy (34). "Health literacy has been seen as a way of minimizing gaps in health and a vital strategy of empowerment to improve the influence of people over their health, their ability to seek information or knowledge and their ability to take responsibility for their health" (34). Some cited literature indicates that health literacy is an important factor in health-related behaviors that may undermine efforts by public health to resolve childhood obesity, especially among parents of low educational level (29). Parents with low levels of health literacy are less likely to provide their children with physical activity options and healthful eating, making health literacy a possible contributing factor to childhood obesity. Moreover, the health literacy abilities of poor parents have repeatedly been related to their children's poorer health outcomes (35). The effect of poor understanding of a health problem on parent's perceptions of associated health risks is one reason why poor health literacy can influence childhood obesity rates. Previous literature found that parental health awareness was one of the variables affecting the accuracy of parental perceptions (29).

In most Arabs, there is a scarce study exploring the relationship between parental factors such as the understanding of childhood obesity and the weight status of their children. To get a better image of childhood obesity in Libya, earlier studies have left several study gaps that need to be filled. The correlation between actual factors and obesity status such as low physical activity, sedentary lifestyle, Libyan unhealthy diet which is rich in calories and sweetness, artificial feeding, low socioeconomic status, working mother, and sleep deprivation, has been explored in previous studies of childhood obesity in Libyan context, however, no study has so far evaluated the association between parenting. Because obesity is rapidly growing in Libya's young teaming population and recognized significant mortality and morbidity, awareness of Libya's policymakers, researchers, as well as the healthcare community is paramount. This research would be useful for the area of social and public health (Community Health) in Libya and can provide community health developers and stakeholders in Libya with valuable knowledge as it has targeted a group of Libyan elementary or primary school pupils. Greater literacy, perception, and interest in parental health are likely to facilitate more active regulation and monitoring of the lifestyle and weight of a child and better behavioral management outcomes for childhood obesity. However, the research remains unknown or unpublished concerning perception of the parent of childhood obesity and their children's obesity status in Libya, so, this study will unveil the relationship between parental

perceptions of childhood obesity, parental health literacy, and childhood obesity to use the result to establish successful programs to reduce the burden childhood obesity in Libya. Given the prevalence, health consequences, and cost associated with childhood obesity, there is a need for a significant understanding of the health literacy of parents, perhaps the health (weight gain) of their children will be effectively prevented or controlled. The research of the study is what are the associations between Libyan parents' perception of childhood obesity, health literacy, and the Body Mass Index of their children in the West area of Libya? In addition, the objective of the study is to determine the association between Libyan parents' perceptions, health literacy of childhood obesity, and the Body Mass Index of primary school children in the western area of Libya. The study hypothesis is that parental perception of childhood obesity health literacy is linked to the Body Mass Index of their children in the western region of Libya.

Methods

Study Design

A cross-sectional study was conducted to measure parental perceptions of childhood obesity, parental health literacy status, and the BMI of their children from December 2018 to April 2019. To address the research questions and achieve the study objectives, this design was chosen as the most suitable design. A cross-sectional study is a type of observational study that analyses data collected at a single point in time from a population and is considered to be relatively inexpensive, simple, and easy to conduct since data on all the variables is collected only once (36).

Ethical Considerations

Before starting to collect data (Reference number UM. TNC2/UMREC-328), this study was sent to the research committees of the University of Malaya Research Ethics Committee (UMREC). The study was sent to the Ethics Committee, which is a branch of the Ministry of Education in Libya, within the Office of Evaluation and Education in the Western Region of Libya. Before starting the study, ethical approval was obtained from both organizations. Approval was received from the school committee of the school of each chosen nation. Each parent obtained informed written consent, and the researcher asked the parent to sign the consent form if they wished to participate with their child in the study. The research team was responsible for any medical requirements related to the study. Without any repercussions, parents and their children were allowed to withdraw from the research. All information was also kept confidential, and no identifying information was ever published.

Participants, Libya Education System and Study Area

Libya's education continues with free and compulsory elementary education. In Libya, children between the ages of 6 and 12 attend primary school and then go to secondary and high school for another six years (12- to 18-year-olds). Around 60 % of students are assigned to a secondary vocational program, while the remaining 40% are assigned to a more academic-focused program (37). The study was conducted in the West of Libya. Libya is an Arabic country located in the Maghreb region of North Africa, bordered by Tunisia and Algeria from the west, the Mediterranean region from the north, Chad and Niger from the south, Sudan from the southeast, and Egypt from the east (Figure 1). Both Libyan people speak the Arabic Language and are Muslim. Libya has a four-season climate and the country has a population of 6.202 million with an area of 1.8 million square kilometers (38).

The study was conducted in Libya's western cities, including six cities in the western region; Zuwarah, Az Zawiyah, Surman, Subrata, Riqdalin, and Aljmail (Figures 2 & 3). The researcher chose the western area to perform the current study because the trend of childhood obesity in the western region of Libya is high, According to the Libyan Ministry of Health, 2018, the prevalence of childhood overweight and obesity was 13.4% in 2003, 21.3% in 2014 and 27 % in 2017 and the small number of childhood obesity were carried out in the capital of Libya (Tripoli), and (Benghazi). There is a lack of published studies researching childhood obesity in western region of Libya about parental factors such as the understanding of childhood obesity by parents and health literacy by parents (25).

Study Population

The parents of government primary school students aged 6 to 12 years who were enrolled in West City primary schools during the study period were the study population of this study. Under the Child Act, of 2001, a child is classified as a child is a person 19 years of age or younger unless a person is defined by national law as an adult at an earlier age" (Child Act, 2001) According to the Libyan Ministry of Education, the age of the Libyan primary school students varies from 6 years to 12 years. As this study was conducted among primary school students, this age was therefore chosen by the researcher as a suitable age that met the study population criteria.

Sampling Frame

The sampling frame is the list of all parents of the government's primary school students aged from 6 to 12 years old who are registered in Western cities' primary schools during the study period.

Inclusion criteria

Specific inclusion criteria were established to obtain the appropriate parents and these include parents willing to participate in the study, parents of governments primary school students (6 to 12 years old), Libyan and students aged between 6-12 years old, and Libyan.

Exclusion criteria

Parents who are unable to read (illiterate parents) and students with a secondary cause of obesity such as Cushing syndrome, Hypothyroidism which were on medications (e.g., Corticosteroids), pre-existing chronic diseases or handicapped, students with any known organic causes for obesity or underweight, and on long term medications. This information was collected employing each student's file. Each student has a school file containing his or her records, medical data, and any health issues. When the students begin each new year, these details are filled in.

Sample Size Estimation

The main objective of the sample size measurement for this analysis was to evaluate the correlation between parental factors (parents' perception of childhood obesity, parents' health literacy) and their children's obesity status; as the main objective of this study is to establish the association between parental perceptions of childhood obesity, parental health literacy, and obesity status. The sample size was computed using the G*Power 3.1.9.2 software. To measure the sample size, the logistic regression test was used, the Alpha level of 0.05 was taken at the power of 80% and the effect size used was based on the literature review (Odds Ratio), the one-sided (one tail) test was used.

Table 1 shows the estimation of the sample size using various effect sizes. The effect size was chosen between the correlation of obesity status and precise parental perception (952). A well-known low response rate among parents (39) was based on the previous literature review, thereby inflating the sample size by taking into account a 20% non-response rate.

Sample size = 952 (G*Power) +20% (non-response rate)

Sample size = 952+ 190 = 1142 respondents. In this report, the number of schools reported to be involved was 15 schools. Estimated sample size per school = 1142 /15 = approximately 76 subjects per school, roughly. Overall, 1157 respondents were recruited, thus exceeding the requirement for this research.

Sampling Method

In the West region of Libya, there are 43 government primary schools. Schools are in urban and rural areas, but most schools are in urban areas. The schools are very similar; all primary school levels (from level 1 to level 6) are included; each level has from 5-7 classes of around 23 -28 students per class. Total numbers vary from 850-1176 per classroom (25). Two-stage cluster sampling was used to recruit parents of students who were representatives of all primary school parents in the western region of Libya. Two-stage cluster sampling offers good coverage, is easy to introduce, and enables the quality of field-work to be monitored (40). As two of the schools were omitted (one from the rural area, and one from the urban area), only 41 schools were included in the actual study because they were included in the validity and reliability tests of the questionnaires, as stated in phase one.

Study Variables

The independent variables are parents 'perceptions of childhood obesity, and parents' health literacy whereas the dependent variable consists of children's obesity status (BMI).

Data Collection

Two types of data collection methods were used in this study, including; the Arabic versions of the Health Literacy Questionnaire (HLS-EU-Q47) and the Childhood Obesity Perceptions (COP) Survey, as mentioned above, were used to assess parental health literacy and the perception of childhood obesity by parents (3.3). Anthropometric measurements of the selected children were standardized and calculated by trained (qualified) staff nurses using standard instruments. BMI was determined by dividing weight by the height square. Weight was measured in kilograms using a properly calibrated digital electronic children's weight scale (SECA 803, Hamburg, Germany) with a standing and barefoot subject, as recommended by previous research (41) by Libyan researchers in the public health field (42). A portable Stadiometer (SECA 213, Hamburg, Germany) was used to measure height in meters as recommended by previous studies (43,44) and twice to the nearest 0.1 centimeters (45). The research team measured the Body Mass Index (BMI) as weight (kg) divided by height squared (m^2) using the BMI Child and Teen Percentile Calculator (46). A Gulick fiberglass tape was used to measure the waist circumference was measured in cm (47). A horizontal measure was taken at the narrowest point of the torso above the umbilicus and below the ribcage, with the student standing, abdomen relaxed, and feet slightly apart (48).

Data analysis

Bivariate analysis (Two-way Analysis of variance) was applied to investigate the connection between parental perception, and children's body Mass Index. In multivariate analysis, structural equation modelling (SEM) was used to estimate the relationship between parental perception and children's Body Mass Index.

Results

Children's BMI against parents' factors (perceptions of childhood obesity and, health literacy)

The ANOVA findings for children's BMI against parental factors (perceptions of childhood obesity and, health literacy) are shown in Table 2. At a 95% confidence level, the assumption that all the means of the groups within the variable are equal should be rejected as the significance value is less than 0.05. The results show that parents with a low level of perception (underestimation) are significantly correlated with their children's higher BMI ($f(2, 109) = 0.804$, $p = 0.044$, partial $\mu 2 = 0.001$) relative to parents with normal levels of perception. In addition, parents with inadequate levels of health literacy were significantly correlated with their children's higher BMI ($f(2,109) = 0.719$, $p = 0.038$, partial $\mu 2 = 0.001$) compared to parents with an adequate level of health literacy. The estimated mean shows the underestimation of the parents' group and insufficient health literacy group have higher means. Thus, based on the significant p-value, we can infer that a higher BMI relative to other groups is correlated with an underestimation group and an insufficient health literacy group. There was no significant p-value ($f(3, 109) = .2.236$, $p = 0.082$, partial $\mu 2 = 0.006$) for the interaction between perceptions * health literacy, suggesting that the relationship between parental perceptions and parental health literacy has not changed the relationship between parental perceptions, parental health literacy, and Body Mass Index.

In conclusion, it can be inferred that groups are not equal in terms of means. The hypothesis that there is an association between the variables of Libyan parents' factors (perceptions of childhood obesity and, health literacy) and the Body Mass Index is therefore accepted.

Assessment of Measurement Model for Parents (Formative Model)

The result showed that, the variance inflation factor (VIF) was in an acceptable range (below the conservative cut-off of 2.5). This implies that there was no overlap between the variance of all measures in each construct. In this measurement model, it is suggested that multi-collinearity is not likely to be a serious problem. In all related constructs, the outer weights, t values, and the significance of the outer weights for each indicator were tested. The results in Table 3 suggested that all the external weights for exogenous construct-related measures are significant at the

significance level of $p = 0.001$, which is less than $p < 0.05$. The outer weights are acceptable for all paths. The t-statistic test was used to test if the indicators of exogenous constructs contributed to the independent construct. All t values are greater than the cut-off point (1.96) and these findings endorse the outer indicator weights in each exogenous construct. In summary, the results have shown that the model has reached the recommended acceptable levels of outer weights, t values, p values, and VIF.

Assessment of Structural Model for Parents

In this study, the structural model using PLS is evaluated on the grounds of three main statistics, i.e., the path coefficient (β) and the bootstrap statistics (t-value and p-value).

Collinearity and Path Analysis of Endogenous Construct (Relationships Hypothesis Testing)

Multi-collinearity in sets of predictor constructs can be dealt with using SEM. If two or more constructs are not independent, multi-collinearity occurs, which is a matter of degree and is identifiable. A conservative cut-off point (VIF value of greater than 2.50 indicates a probable collinearity problem) is a VIF value of 2.50 based on previous researches (49). The highest VIF value for the endogenous construct was 1.673 (below the conservative cut-off of 2.5) as shown in Table 4 for this model, which shows that the issue of multi-collinearity between study constructs does not exist.

The structural model can be used by evaluating the relationships among the research constructs. The research hypotheses are shown in Table 4.

The structural equation model was used to evaluate the research hypotheses. According to the research model, the effects of the independent constructs including parental perception of childhood obesity and parental health literacy (health care, disease prevention, and health promotion) were evaluated. Figure 4 shows the path model.

To test the significance of the proposed research hypotheses for the first model, the bootstrapping method was used. The random re-sampling of the original dataset requires bootstrapping to produce new samples of the same size as the original dataset. This approach not only measures the reliability of the dataset but also examines the statistical significance of these coefficients and the error of the calculated path coefficients afterward (50). For each endogenous construct, the standardized path coefficients (β) and t values, and the significance of the paths were evaluated. The t-value of the items ranged from 2.97 to 8.845 (Table 6) and the p-value of all paths is significant ($p < 0.05$), with negative and acceptable path coefficients (β) for all paths, except for the path between disease

prevention domain of health literacy and BMI, (the association is weak but significant). Specifically, the findings indicate the negative and significant relationship between the perception of childhood obesity by parents with a child's BMI ($\beta = -0.234$, $t = 8.557$, $p < 0.05$), a child's BMI health care domain ($\beta = -0.258$, $t = 8.845$, $p < 0.05$), a child's BMI disease prevention domain ($\beta = -0.087$, $t = 2.975$, $p < 0.05$), and a child's BMI health promotion domain ($\beta = -0.204$, $t = 7.308$, $p < 0.05$). These findings help the study hypotheses. Based on the above measures, the study therefore found that the perception of childhood obesity by parents and the health literacy of parents is significantly and negatively correlated with the BMI of their children (underestimation and insufficient health literacy level of parents associated with higher BMI of their children and the vice versa).

Assessment of Effect Size (f^2)

The effect size (f^2) can be measured to assessing the strength of the relationships. Guidelines for the assessment of f^2; $f^2 \geq 0.02$, $f^2 \geq 0.15$ and $f^2 \geq 0.35$, respectively, reflect the exogenous construct scale of small, medium, and large effects size (51). According to Table 7, the result of f2 showed that the effect size of exogenous constructs was assumed to be small in the first model (a small amount of contribution).

Assessing the Predictive Relevance (Q^2) and Coefficient of Determination (R2) of Parents' Model

An important aspect of a structural model is its capability to determine the predictive relevance (Q2) of the model. Q2 assesses how well the path model can predict the value observed (the ability of prediction). In the first model with a value (0.357), which is greater than zero, the results showed that the Q2 value of BMI recommends that the independent constructs have predictive significance for the dependent construct under consideration (37). As shown in Table 8 in this analysis, the BMI R2 value was (0.366) for the first model and the Adjusted R2 value was (0.363) for the first model. So, the model has a large R2.

In conclusion, Structural Equation Modelling of data from parents indicates that the study hypotheses were endorsed. The perceptions of childhood obesity and the health literacy status of parents are strongly and negatively correlated with the BMI of their children, and the correlation shows a small effect size (f 2) and a high determination coefficient (R2). Parents like fathers and mothers have different effects on the BMI of their children, SEM was again performed separately on fathers' and mothers' data to identify the influence of each parent separately.

Discussion

Parental perceptions, parental health literacy, and Body Mass Index

Previous research indicates that a high body mass index presents a major risk to children's health (14–16). The perception of parents may be related to the BMI of a child, and if parents do not recognize the obesity status of their child, attempts to avoid obesity will be unsuccessful (52). However, depending on the health literacy of parents, the impact may vary. A two-way analysis of variance (ANOVA) was performed in the present study to test the relationship between parental perceptions of childhood obesity, literacy in parental health, and BMI. This research provided evidence of the demographic changes in the BMI of children and the perception of their child's weight status by their parents. The results showed that there is a significant correlation between parental perception and the BMI of their children. This suggests that awareness among parents about the BMI of their children will avoid the subsequent development of obesity. These findings are close to previous research on BMI in children and perception of parental weight (53). This is in agreement with the findings of Kroke, Strathmann, and Günther (54), who report that the mother's misunderstanding of the 6-month-old overweight child hurts the weight growth of the child compared to mothers who better recognize the weight status of their child. This is not in agreement with a recent research conducted among Australian children to investigate the social and cultural environments of children to their weight status and well-being, the study did not find the connection between the misperceptions of parents about the weight status of children and the weight gain of their children (55).

A possible cause of parental misconception may be parental misunderstanding of the weight status of their children (56). Firstly, parents may not accept that their children are overweight. Another explanation may be that the concept of being overweight is not understood by parents. The results of Jain et al. (57) who conducted qualitative interviews with low-income mothers to understand their perspectives on the overweight of their children, indicate this. The authors found that the classifications used by health professionals to assess the overweight of the children were not supported by these mothers. Other studies have reported that the perception of parents of the weight status of their child is related to the overweight status of the mother herself, which may influence their normal weight standard (58–60). The current findings have an impact on programmes for childhood obesity. The recognition of overweight by parents for a long time is very critical for obesity intervention (61,62). Therefore, consistently measuring the efficacy of child measurement

and obesity screening strategies provided to parents is now more important than ever (63). As clarified by the Social-Ecological Mode, the perceptions of childhood obesity by parents need a system-thinking approach. This was supported by one study that showed because of the multiple effects and interactions on the behavior of the child and parents, the Social Ecological Model is important for the relationship between parental perception and childhood obesity (64).

In addition, the present study showed that an inadequate level of parental health literacy was found to be significantly associated with higher BMI of their children. It illustrates that being overweight or obese is significantly correlated with poor health literacy. That is to say, the better the level of health literacy at the parental level, the better the weight status of their children, suggesting that the two have a significant relationship. Since the increase in health literacy represents a decrease in BMI, it can be inferred that the increase in health literacy also reflects an increase in nutritional levels. Parents with inadequate levels of health literacy have higher children's BMIs, while participants with higher levels of literacy have lower children's BMIs. Another research indicates that there is a strong negative association between health literacy and BMI Z Scores (65).

In this study, the estimated low Libyan parental health literacy status obtained can be compared with that recorded in the literature, especially by Chang (66) who found that 41% of the respondents had a low level of health literacy and, only 10% had a high level of health literacy. In the context of a broader range of factors influencing health literacy, the correlation between low health literacy and obesity can be understood. Health literacy has been calculated to be closely linked to the general level of literacy of the population, academic, and school performance (67). In addition, some individuals suggest that it may also be a factor in promoting general health awareness to access knowledge and educational resources through the internet (68). The low levels of health literacy of parents are correlated with many aspects of the health of children, including body weight (65). Therefore, the present study findings have public health implications for the critical global issue of the weight of the children.

Parental formative measurement model

This research aims to examine possible variables that may lead parents to underestimate their children's weight status. The parental formative measurement model was further explored by the study. The results showed that there is a significant correlation between the perception of childhood obesity by parents, health literacy, and the body mass index (BMI) of their children, translating to a lack of parent health literacy, and low perception is significantly associated with higher BMI in

their children. The study established the independent constructs that have predictive significance for the dependent construct under consideration in assessing the predictive relevance of Q^2 and the coefficient of determining the parent model (37). The results of the study support the pattern recorded in the literature that suggested that parents who underestimate the weight of their children did not realise the obesity status of their children, leading to a higher BMI in their children (69). The correlation between the social determinants of health and the underestimation of the weight status of their children by parents remains uncertain, with some studies reporting an important relation, while others do not (70).

As for the evaluation models of fathers, there seems to be a significant association between the perception of childhood obesity by fathers and the health literacy of fathers, the BMI of children, which suggests that a father's lack of health literacy is related to a significant association BMI of their children. Similar results were found in the model evaluation of mothers, whereby the perception of childhood obesity and health literacy of mothers was significantly and negatively related to the BMI of their children.

Study Limitation

Some limitations were identified; first of all, the nature of the study design (cross-sectional study). Causal relationships from cross-sectional analysis are difficult to derive, the research did not conclude on the causal relationships between the perception of childhood obesity by parents, the health literacy of parents, and their children's obesity status, the study only obtained association (the degree of relationship between parents' factors and childhood obesity). Self-report bias may occur due to perceptions of participants of the BMI of their children and the reporting of their children's weight and height measurements. However, previous studies have shown that this kind of bias is important to accept as part of investigations (71). In addition, the research team measured the weight and height, which provided the researcher with an opportunity to compare the reporting of parents with the actual weight and height measured by the research team. Moreover, the bias may exist due to the use of questionnaires, but, as the instruments were well-validated among Libyan parents, the bias is too small to impact or alter the results.

The surveys were distributed in envelopes and asked the parents to fill up at home; so other family members such as an aunt or a grandmother living in the household might complete the survey. The study did not use the methods of qualitative research methodology to obtain an in-depth understanding of the variables of parents and the BMI relationship of their children. It is therefore

recommended to use the qualitative research approach in future research to gain an in-depth understanding of the variables of parents and the BMI relationship of their children.

Conclusion

In conclusion, all the study objectives and questions to be discussed have been reached and answered. For the above reasons, the findings provide a clearer understanding of the influence of effects of parental influences (perception of childhood obesity and, health literacy) on the BMI of their children.

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval

Ethics approval for this study was obtained from the University of Malaya Research Ethics Committee (UMREC) (Reference number UM. TNC2/UMREC-328) and branch of the Ministry of Education in Libya, within the Office of Evaluation and Education in the Western Region of Libya. Approval was received from the school committee of the school of each chosen nation. Each parent obtained informed written consent, and the researcher asked the parent to sign the consent form if they wished to participate with their child in the study. All information was also kept confidential, and no identifying information was ever published.

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Table 1: Results of sample size calculation based on different effect size

Childhood Obesity	Parental Factors	Odds Ratio (OR)	Sample Size	Reference
Childhood Obesity (BMI z score)	Accurate parental perception	0.817	952	(72)
Childhood Obesity (BMI)	Excellent parental health literacy	0.75	473	(73)

Table 1: Two-way analysis of variance showing the significant values of variables, the estimated mean and the interaction effect

Variable	df	Mean (Std. Error)	F	Sig	Partial μ^2
Perception	2		.804	0.044	0.001
Underestimation		18.242 (.814)			
Correct estimation		17.268 (.326)			
Over estimation		17.734 (.336)			
Health Literacy	2		.719	0.038	0.001
Insufficient		18.905 (2.59)			
Sufficient		16.07 (2.37)			
Perception*Health Literacy	3		2.236	0.082	0.006

Table 2: Evaluation of formative measurement model for all constructs (parents' model)

Construct	Indicator	Outer weight	SE	T value	P Values	VIF
PR*	PR RS	0.325	0.078	5.137	0.001	1.053
	PR WS	0.722	0.067	5.229	0.001	1.034
	PR FB	0.199	0.066	8.333	0.001	1.038
	PR PR[1]	0.368	0.073	3.198	0.001	1.028
	PR.HC. F	0.287	0.059	3.356	0.001	1.278

HC	PR.HC. U	0.275	0.06	4.824	0.001	2.003
	PR.HC. J	0.338	0.072	3.809	0.001	2.046
	PR.HC. A	0.392	0.066	5.088	0.001	1.514
	PR.HP. F	0.204	0.061	6.453	0.001	1.351
HP	PR.HP. U	0.454	0.062	3.308	0.001	1.055
	PR.HP. J	0.216	0.059	7.756	0.001	1.375
	PR.HP. A	0.54	0.055	3.916	0.001	1.038
DP	PR.DP. F	0.351	0.05	10.784	0.001	1.135
	PR.DP. U	0.233	0.056	6.599	0.001	1.081
	PR. DP. J	0.548	0.055	5.914	0.001	1.157
	PR.DP. A	0.36	0.048	14.923	0.001	1.148

PR= Parents, PR* = Perception, RS= Risk Factors, WS= Weight Status, FB= Facilities and Barriers, PR[1]= Programs, HC=Health Care, HP= Health Promotion, DP= Disease Prevention, F= Finding, U= Understanding, J= Judging, A= Applying health information

Table 3: Variance inflation factor values of the endogenous variable (BMI)

Construct	**VIF**
Perception	1.279
Health care	1.674
Disease prevention	1.489
Health promotion	1.538

Table 4: The relationships between researches constructs

Hypothesis	**Path**
H1: Parental perception of childhood obesity is associated with Body Mass Index of their children in West area of Libya.	PR → BMI
H2: Parental health literacy status is associated with Body Mass Index of their children in West area of Libya.	
H2.1: Health care domain of health literacy associated with Body Mass Index.	HC → BMI
H2.2: Disease prevention domain of health literacy associated with Body Mass Index.	DP → BMI
H2.3: Health promotion domain of health literacy associated with Body Mass Index.	HP → BMI

Table 5: Results of path model evaluation for parents' model

Path	β	SD	T value	P Values	Result
PR → BMI	-0.234	0.027	8.577	0.000*	Supported
HC → BMI	-0.258	0.029	8.845	0.000*	Supported
DP → BMI	-0.087	0.029	2.975	0.003*	Supported
HP → BMI	-0.204	0.028	7.308	0.000*	Supported

PR=Perception, HC=Health Care, HP= Health Promotion, DP= Disease Prevention, BMI= Body Mass Index, Significance Level = *p < 0.05

Table 6: Effect size (f^2) of exogenous constructs (parents' model)

Exogenous constructs	f^2
Perception	0.068
Health care	0.063
Health promotion	0.043
Disease prevention	0.086

Table 7: Predictive relevance (Q^2) and coefficient of determination (R^2) of parents' model

Endogenous variable	R^2	Adjust R^2	Q^2
BMI	0.366	0.363	0.357

Figure 1: Map showing the location of Libya in the Arab world. Source: Google Maps. Retrieved from https://www.google.com/maps/

Figure 2: Map showing the location of the western cities in the map of Libya. Source: Google Maps. Retrieved from https://www.google.com/maps/

Figure 3: Map showing the cities of the western area of Libya (Az Zawiyah, Surman, Zuwara, Subrata, and Aljmail). Source: Map of Libya, Retrieved from; https://www.lonelyplanet.com/maps/africa/libya/

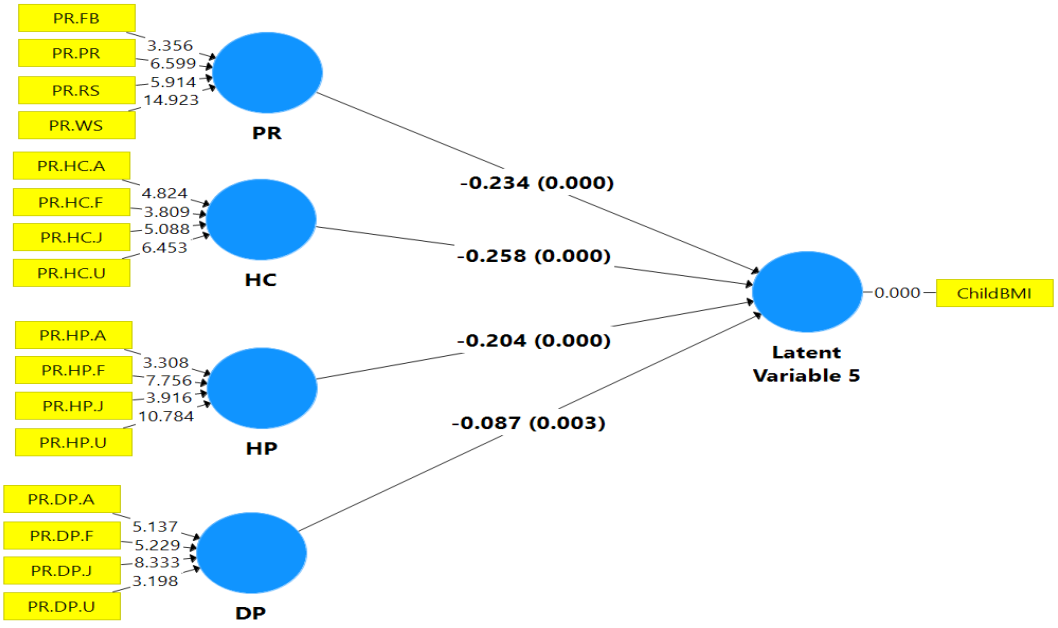

Figure 4: Path model related to parents (bootstrapping)