

Original Research

Pediatric Obesity and Its Long-Term Health Consequences: Ways to Decrease Burden and Enhance Health-Related Quality of Life in Early Days.

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Abstract

Childhood obesity is a significant global health issue with long-term consequences for individuals and society. Genetic, behavioural, environmental, and socioeconomic factors contribute to the development of childhood obesity. It is associated with various adverse health outcomes, including cardiovascular disease and psychological disorders. While the effects of childhood obesity are well-known in developed countries, less attention has been given to its impact in developing countries. Effective preventative strategies that consider the complex interaction of factors are needed. Promising interventions include family-based approaches, increased physical activity, and reduced sedentary behaviours. Digital health technologies and mobile applications show potential for behaviour change and monitoring. Policy and environmental changes, early childhood education, and school-based interventions have also proven effective. However, long-term follow-up and sustainability of interventions are essential for reducing childhood obesity and improving health-related quality of life. Cultural competency and tailoring interventions to diverse populations are crucial. Evaluation of intervention outcomes and methodological considerations should be undertaken to determine effectiveness. Long-term impacts and maintenance of behaviour changes are important for sustained results. Comprehensive strategies are necessary to address the global burden of childhood obesity and its associated health consequences.

Keywords: Childhood obesity, Prevention, Interventions, Digital health technologies, Policy changes, physical activity, sedentary behaviours, evaluation, cultural competency.

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INTRODUCTION

Childhood obesity is one of the most significant health and wellness issues of the twenty-first century, with huge long-term morbidity and mortality, contributing to primary sources of adult death such as cardiovascular disease, insulin resistance, and type 2 diabetic issues mellitus^{1,2}. The frequency of paediatric obesity is quickly increasing worldwide, and the illness burden is rising exponentially³⁻⁵. A complex combination of genetic, behavioural, environmental, and socioeconomic variables influences childhood obesity^{3,6-8}. Obesity has a negative impact on health and wellness both during childhood and later in life, increasing the risk of developing metabolic syndrome, cardiovascular disease, type 2 diabetes, and the associated retinal and renal issues, obstructive sleep apnea and non-alcoholic fatty liver disease, polycystic ovarian dysfunction, inability to conceive, and psychological conditions^{1,3,7}.

While the long-term effects of childhood obesity are well-known in developed countries, less attention has been paid to the negative effects in developing countries^{2,5}. In 2019, 38 million children under the age of five were obese or overweight worldwide. Excessive weight has considerable effects on the psychological health and wellness of children



enhancing the frequency of clinical depression, anxiety, and also reduced self-worth in a child's developmental years^{1,2,5}. Early childhood obesity is influenced by exposure to maternal obesity, environmental obesogens, poverty, food insecurity and nutritional quality^{5,7}. Recognising the threat elements, factors, and also effects of childhood weight problems is critical for developing dependable preventative approaches^{1,3,5,9}

In a nutshell, childhood obesity is a growing worldwide public health and wellness concern with long-term implications on both an individual and social level. While monitoring childhood obesity has generally focused on weight reduction, early treatment through preventative measures is critical to reducing disease anxiety and increasing health-related lifestyle in the early days. Furthermore, an all-natural approach based on the intricate interplay of hereditary behavioural, ecological, and socioeconomic elements must be taken into account. The paper underlines the need for greater public health research, as well as the long-term repercussions of childhood obesity, and proposes more reliable preventative approaches.

METHODOLOGY

Inclusion and exclusion criteria for selecting relevant studies:

Relevant studies were included if they explored the adverse effects associated with childhood obesity, the management efforts for dealing with childhood obesity, and the consequences of childhood and adolescent obesity, both nationally and internationally. Studies were excluded if they focused on adults, animals, or specific medical conditions such as diabetes.

Search strategy and databases utilized:

PubMed, PsychINFO, and other relevant databases were systematically searched to find studies published between 1999 and 2021. The search keywords included "childhood obesity," "overweight," "management," "health consequences," "socioeconomic inequalities," "psychological comorbidities," "physical comorbidities," "media consumption," "TV viewing," "dietary management," "global perspective," and "Middle East and North Africa (MENA) region."

Analysis and synthesis of the literature:

A narrative synthesis approach was used to analyze the literature based on identified themes. Studies were grouped by region, type of intervention (behavioral, environmental, technological, and dietary), and the consequences of childhood obesity (psychological, physical, and social).

Limitations of the review:

The limitations of this review include potential publication bias, as studies with significant results are more likely to be published. Another limitation is that studies conducted in low- and middle-income countries might have been underrepresented in the review. Finally, the quality of studies varied, and some studies had a small sample size, which might affect the generalizability of the findings.

UNDERSTANDING CHILDHOOD OBESITY

Childhood obesity is defined as "a medical condition that affects children and adolescents primarily caused as a result of an excess of body fat"¹⁰. The measurement of obesity in this population is commonly done using the body mass index (BMI), which takes into account the individual's weight and height. Obesity in children is typically categorized using percentiles, with those at or above the 95th percentile considered obese. The etiology of childhood obesity is multifactorial, involving a combination of genetic, behavioral, and environmental factors. While genetics can contribute to the predisposition of obesity in some cases, modifiable lifestyle behaviors play a significant role in the development and progression of childhood obesity^{2,11}. Physical inactivity including a lack of regular exercise and sedentary behaviors such as prolonged screen time, further exacerbates the energy imbalance and contributes to weight gain. In addition to behavioral factors, environmental influences also contribute to the prevalence of childhood obesity. The availability and accessibility of unhealthy foods, such as high-calorie snacks and sugary beverages, in schools, neighborhoods, and communities contribute to poor dietary choices².

Obesity is a prevalent chronic disease that has been on the rise globally in recent decades. The World Health Organization (WHO) reports that the number of overweight or obese children under the age of five has exceeded 42 million worldwide, and this figure is projected to continue increasing. By 2025, it is estimated that the number of overweight or obese children will reach 70 million. The Centres for Disease Control and Prevention (CDC) uses age and gender-specific body mass index (BMI) percentiles to identify childhood obesity. These percentiles are based on CDC growth charts for children aged 2 to 19 years¹.

Obesity in childhood is a complicated disorder caused by a mix of behavioural, environmental, and genetic variables. fat parents put their children at an increased chance of becoming fat themselves, showing that the condition has a hereditary component. In fact, genetic variables are thought to account for 40 to 70% of the variance in BMI¹². Contributing factors include changes in the food environment, family history, physical inactivity, increased sedentary behavior, and insufficient sleep¹³. Aside from hereditary considerations, there are various other variables that contribute to juvenile obesity. Changes in the eating environment, such as the availability of unhealthy foods, might contribute to obesity development. Childhood obesity risk factors include family history, physical inactivity, increasing sedentary behaviour, and inadequate sleep. Furthermore, the type of newborn nutrition a kid receives may increase his or her chance of becoming overweight¹⁴.

Childhood obesity is a concern not only because of its influence on weight and physical health, but also because it is linked to the development of a number of comorbidities. Hypertension, type II diabetes, nonalcoholic fatty liver disease, dyslipidemia, polycystic ovarian syndrome, pulmonary and orthopaedic conditions, and psychological issues such as depression, anxiety, substance misuse, somatization, and



eating disorders are examples of these¹. Figure 1. Illustrates this in a concise manner.

HEALTH-RELATED QUALITY OF LIFE (HRQOL) IN EARLY CHILDHOOD

HRQoL refers to the physical, psychological, social, and emotional aspects of well-being that impact an individual's life. In early childhood, the HRQoL domains affected by obesity include physical, psychological, social, and emotional well-being⁵. Measuring HRQoL in early childhood is challenging because children's cognitive and language skills are not yet fully developed. Researchers use parent or self-reported questionnaires, health care professional evaluations, and behavior observations to measure HRQoL¹⁵. It is evident that childhood obesity has a negative impact on HRQoL, with children experiencing low self-esteem, teasing, and isolation^{15,16}.

STRATEGIES TO REDUCE BURDEN AND IMPROVE HRQOL

Promising improvements and creative therapies have developed to reduce the burden of childhood obesity and improve early childhood quality of life. These methods include a wide variety of initiatives, such as legislative and environmental changes, early-childhood interventions, and collaborative efforts involving healthcare professionals, legislators, communities, schools, and families^{2,11,15}. Several strategies, including the promotion of breastfeeding and appropriate infant feeding practises, early childhood education initiatives, interventions promoting healthy behaviours, and school-based programmes incorporating nutrition education, physical activity promotion, and the establishment of healthier food environments, have shown efficacy in this regard. It is also critical to include parents, carers, and families in fostering healthy lifestyles that prioritise greater physical exercise while minimising excessive screen time. Encouraging parents, caregivers, and families to promote healthy lifestyles that incorporate increased

physical activity and reduced screen-using habits also plays a critical role^{2,16,17}. As cited in¹⁸, early interventions targeting rapid weight gain before early childhood can prevent child obesity and its consequences. Prevention strategies targeting early childhood, including prenatal, infancy, and preschool interventions, have been shown to be effective in reducing the burden of childhood obesity¹¹. According to¹¹, developing potent and optimized interventions requires a multiphase approach that involves screening intervention components, refining intervention designs, and evaluating the efficacy of the components. Involving caregivers and parents in promoting healthy lifestyles plays a crucial role in preventing childhood obesity as per. Encouraging breastfeeding and appropriate infant feeding practices have also been identified as key strategies in preventing obesity¹⁹. School-based interventions that include nutrition education, physical activity promotion, and healthier food environments have also shown effectiveness in reducing the burden of childhood obesity¹¹. Collaboration between healthcare providers, schools, communities, policymakers, and families is of utmost importance as per¹¹. Policy and environmental changes are also essential to provide support for healthy lifestyles¹¹. In low-income countries with poor infrastructure problems, lack of parks or sidewalks, poverty, unsafe water supply systems affect the children due to inadequate sanitation, which necessitates changing the environment to overcome this as per²⁰.

Clinicians, as cited by²¹, can play a role in educating parents about childhood obesity and regularly monitoring their child's growth. HCP's perception of childhood obesity is also crucial, influencing their level of concern, and their perceived consequences of childhood obesity, as per²¹. Factors that HCP's perceive as important in the development of childhood obesity include parental factors and contextual factors. Barriers to childhood obesity prevention and management include inefficient healthcare systems and cultural beliefs²¹.

In conclusion, the prevention of childhood obesity requires a multiphase approach that includes screening intervention

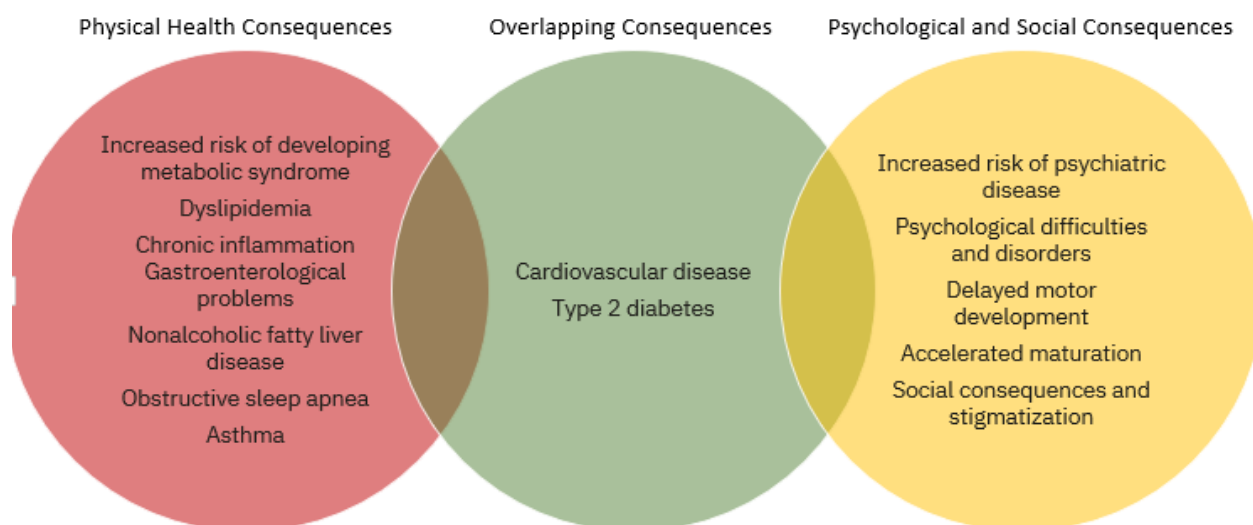


Figure 1. Conditions caused or worsened in children with obesity

components, refining intervention designs, and evaluating efficacy. Early interventions targeting rapid weight gain, proactive parental and community involvement, adequate interventions, and promotion of physical activity through policy changes aimed at creating an enabling environment remain the cornerstone of childhood obesity prevention and management. To ensure effective and sustainable prevention of childhood obesity and its complications, cost-effective measures that cater equally for individuals in all classes and cultural backgrounds must be adopted and implemented.

INNOVATIVE APPROACHES AND PROMISING INTERVENTIONS

Promising interventions primarily focus on family-based interventions, physical activity, and reducing sedentary behaviors. Increasing physical activity among children through policy changes, environmental planning, and educational efforts in schools and communities provides more opportunities for physical activity^{10,17,22}. Additionally, parent-focused interventions that improve the home environment and establish healthy behaviors have proved effective¹⁶. Digital health technologies and mobile applications are emerging as tools for remote behavior change and monitoring. Digital health technologies and mobile applications for behavior change and monitoring: Pan et al¹⁶. states that "extreme obesity is a unique subset of childhood obesity that has increased significantly over the past two decades." This alarming increase in childhood obesity can be addressed using innovative approaches such as digital health technologies and mobile applications for behavior change and monitoring. According to a systematic review by Flynn et al²³., interventions conducted in the home setting that include parents/families were effective in preventing childhood obesity. Parents can use digital health technologies to monitor their children's dietary intake, physical activity, and other behaviors that influence childhood obesity. Digital health technologies, such as mobile apps, can provide educational information aimed at improving lifestyles.

Family-based interventions focusing on behavior modification and healthy habits: Staniford et al²⁴. highlight that intervention strategies to combat childhood obesity must incorporate strategies that promote autonomous and self-regulated motivation, which would enhance families' confidence in sustaining behavior changes independent of health professional support. Integration of parental involvement for behavior modification is a central component of family-based interventions. Families are taught how to make healthy lifestyle choices such as preparing healthy meals, reducing sedentary behavior, and increasing physical activity. According to a study by Sen et al²⁵., a family-based behavioral group treatment and game (Kaledo) interventions were found to be effective in childhood obesity management.

Integration of physical activity into daily routines: It has been suggested that governments and healthcare organizations should take effective actions like policy changing and environmentally safe interventions to improve physical activity in children. Integration of physical activity into daily routines promotes healthy habits and reduces rates of childhood obesity.

According to Bass and Eneli²⁶, there has been a concerted effort globally to develop and implement educational, medical, and public health interventions designed to attenuate the growth of childhood obesity.

Importance of cultural competency and tailoring interventions to diverse populations: Childhood obesity is a significant public health concern, not only nationally but also internationally, especially in Africa. Omotola²⁰ suggests that prevention of childhood obesity gives priority to public health because of its significance on acute and chronic diseases, development, and general health. Health interventions for childhood obesity should be designed with cultural diversity in mind. Cultural competence is key in improving children's and families' engagement, comprehension, and buy-in to the programs. According to Klesges et al²⁷., research studies on behavioral treatments for childhood obesity should report results in a way that better supports pragmatic decision making. They suggest including information on key external validity dimensions, participants, settings, interventions, outcomes, and maintenance of effects. Brown et al²⁸., supports the idea that randomized controlled trials may not necessarily inform us about effectiveness, and there is a need for long-term follow-up and sustainability of interventions.

EVALUATING INTERVENTION OUTCOMES

Effectiveness of interventions in reducing childhood obesity and improving HRQoL: Evaluating intervention outcomes is critical in determining the effectiveness of strategies used in reducing childhood obesity prevalence and improving health-related quality of life (HRQoL). Bass and Eneli²⁶ reported inconsistencies in the effects of interventions to combat childhood obesity. However, family-based interventions focusing on behavior modification and healthy habits were found to be effective²⁵. Studies should, therefore, conduct long-term follow-up to assess effectiveness. Brown et al⁹ indicates that randomized controlled trials are never sufficient alone to evaluate public health interventions. They suggest that other considerations include the need to address cultural diversity and tailor interventions to diverse populations. Evaluation should include key external validity dimensions, participants, settings, interventions, outcomes, and maintenance of effects²⁷.

Long-term impacts and maintenance of behavior changes: The long-term impacts and maintenance of behavior changes are crucial in reducing childhood obesity and improving HRQoL. According to Silver and Cronin (29), evidence suggests that children and adolescents growing up in low-income families and those with underrepresented ethnocultural backgrounds tend to have high prevalence rates of obesity and face more difficulty adhering to childhood obesity interventions. They recommend methods of service delivery that address logistical challenges and are better suited to extended families, particularly grandparents.

CONCLUSION

Childhood obesity is a major public health issue, with long-term



effects such as type 2 diabetes and cardiovascular disease. A multifaceted strategy is required to tackle this condition and its related comorbidities. Policy and environmental improvements, early childhood education, treatments encouraging healthy behaviours, and family-centered programmes have all shown success in preventing and controlling obesity. Furthermore, programmes aiming at boosting physical activity and decreasing sedentary behaviours at the personal, family, and community levels have enormous promise. By using these strategies, we may successfully and sustainably combat childhood obesity. Understanding the combination of genetic, environmental, and societal variables that contribute to obesity is critical for developing targeted and long-term solutions to this complex problem¹⁰.

AUTHOR CONTRIBUTIONS:

Conceptualization: MK ; methodology: SA,MA software:

SA,NA; validation: FA, LA; formal analysis MK; investigation: SA, RA; resources, EA; data curation: AA,YA; writing-original draft preparation: HA,HA; writing-review and editing: MK; visualization: AA; supervision: MK; project administration: MK; funding acquisition: SA,MK. All authors have read and agreed to the published version of the manuscript.

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CONFLICTS OF INTEREST:

The authors declare no conflicts of interest.

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References

1. Pulgarón ER. Childhood Obesity: A Review of Increased Risk for Physical and Psychological Comorbidities. *Clin Ther* [Internet]. 2013 Jan 1 [cited 2023 Jun 11];35(1):A18–32. Available from: <http://www.clinicaltherapeutics.com/article/S0149291812007266/fulltext>
2. Lakshman R, Elks CE, Ong KK. Childhood Obesity. *Circulation* [Internet]. 2012 Oct 2 [cited 2023 Jun 11];126(14):1770–9. Available from: <https://www.ahajournals.org/doi/abs/10.1161/CIRCULATIONAHA.111.047738>
3. Kelsey MM, Zaepfel A, Bjornstad P, Nadeau KJ. Age-Related Consequences of Childhood Obesity. *Gerontology* [Internet]. 2014 Apr 1 [cited 2023 Jun 11];60(3):222–8. Available from: <https://dx.doi.org/10.1159/000356023>
4. Handakas E, Lau CH, Alfano R, Chatzi VL, Plusquin M, Vineis P, et al. A systematic review of metabolomic studies of childhood obesity: State of the evidence for metabolic determinants and consequences. *Obesity Reviews* [Internet]. 2022 Jan 1 [cited 2023 Jun 11];23(S1):e13384. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/obr.13384>
5. Deal BJ, Huffman MD, Binns H, Stone NJ. Perspective: Childhood Obesity Requires New Strategies for Prevention. *Advances in Nutrition*. 2020 Sep 1;11(5):1071–8.
6. IA van B, KS de F, LM B, M van der S, ACS HK. Fat mass and fat-free mass track from infancy to childhood: New insights in body composition programming in early life. *ESPE Year Book* [Internet]. 2022 Sep 12 [cited 2023 Jun 11];19. Available from: <http://www.espeyearbook.org/ey/0019/ey0019.11-9>
7. Must A, Strauss RS. Risks and consequences of childhood and adolescent obesity. *International Journal of Obesity* 1999 23:2 [Internet]. 1999 Apr 26 [cited 2023 Jun 11];23(2):S2–11. Available from: <https://www.nature.com/articles/0800852>
8. McMullen S. Childhood obesity: the impact on long-term risk of metabolic and CVD is not necessarily inevitable. *Proceedings of the Nutrition Society* [Internet]. 2014 [cited 2023 Jun 11];73(3):389–96. Available from: <https://www.cambridge.org/core/journals/proceedings-of-the-nutrition-society/article/childhood-obesity-the-impact-on-longterm-risk-of-metabolic-and-cvd-is-not-necessarily-inevitable/27D76E04933BACB22360FA08B2173AFB>
9. Burrowes JD. Nutrition for a lifetime: Childhood nutrition. *Nutr Today* [Internet]. 2007 Jul [cited 2023 Jun 11];42(4):160–7. Available from: https://journals.lww.com/nutritiontodayonline/Fulltext/2007/07000/Nutrition_for_a_Lifetime__Childhood_Nutrition.5.aspx
10. Goran MI, Reynolds KD, Lindquist CH. Role of physical activity in the prevention of obesity in children. *International Journal of Obesity* 1999 23:3 [Internet]. 1999 Jun 10 [cited 2023 Jun 11];23(3):S18–33. Available from: <https://www.nature.com/articles/0800880>
11. Birch LL, Ventura AK. Preventing childhood obesity: what works? *International Journal of Obesity* 2009 33:1 [Internet]. 2009 Apr 13 [cited 2023 Jun 11];33(1):S74–81. Available from: <https://www.nature.com/articles/ijo200922>
12. Silventoinen K, Rokholm B, Kaprio J, Sørensen TIA. The genetic and environmental influences on childhood obesity: a systematic review of twin and adoption studies. *International Journal of Obesity* 2010 34:1 [Internet]. 2009 Sep 15 [cited 2023 Jun 11];34(1):29–40. Available from: <https://www.nature.com/articles/ijo2009177>
13. Gustafson TB, Sarwer DB. Childhood sexual abuse and obesity. *Obesity Reviews* [Internet]. 2004 Aug 1 [cited 2023 Jun 11];5(3):129–35. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1467-789X.2004.00145.x>
14. Needels MS. Education is Key for Increasing Breastfeeding Duration Among Working Mothers. *Clinical Lactation* [Internet]. 2019 Sep 12 [cited 2023 Jun 11];10(3):121–6. Available from: <https://connect.springerpub.com/content/sgrcl/10/3/121>
15. Hesketh KD, Campbell KJ. Interventions to Prevent Obesity in 0–5 Year Olds: An Updated Systematic Review of the Literature.



- Obesity [Internet]. 2010 Feb 1 [cited 2023 Jun 11];18(S1):S27–35. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1038/oby.2009.429>
16. Pan L, Blanck HM, Sherry B, Dalenius K, Grummer-Strawn LM. Trends in the Prevalence of Extreme Obesity Among US Preschool-Aged Children Living in Low-Income Families, 1998-2010. *JAMA* [Internet]. 2012 Dec 26 [cited 2023 Jun 11];308(24):2563–5. Available from: <https://jamanetwork.com/journals/jama/fullarticle/1487493>
 17. He M, Irwin JD, Sangster Bouck LM, Tucker P, Pollett GL. Screen-viewing behaviors among preschoolers: Parents' perceptions. *Am J Prev Med* [Internet]. 2005 Aug 1 [cited 2023 Jun 11];29(2):120–5. Available from: <http://www.ajpmonline.org/article/S0749379705001352/fulltext>
 18. Fazzino TL, Kong KL. A new paradigm for investigating the etiology of obesity in early childhood: Exposure to added sugars and hyper-palatable foods in infancy and dysregulation of food reinforcement processes. *Obesity Reviews* [Internet]. 2023 Feb 1 [cited 2023 Jun 11];24(2):e13526. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/obr.13526>
 19. Campbell MK. Biological, environmental, and social influences on childhood obesity. *Pediatric Research* 2016 79:1 [Internet]. 2015 Oct 20 [cited 2023 Jun 11];79(1):205–11. Available from: <https://www.nature.com/articles/pr2015208>
 20. Omotola AA. Knowledge and Attitude towards Obesity among Secondary School Students of Royal Crystal College, Ile-Ife, Nigeria. *Texila International Journal of Public Health*. 2017 Mar 31;5(1):134–47.
 21. Lai JF, Clarke J, Wildt G, Meza G, Addo MA, Gardiner E, et al. Healthcare Professionals' Perceptions of Childhood Obesity in Iquitos, Peru: A Qualitative Study. *BMC Health Serv Res* [Internet]. 2021 Jun 4 [cited 2023 Jun 11]; Available from: <https://www.researchsquare.com>
 22. Faienza MF, Wang DQH, Frühbeck G, Garruti G, Portincasa P. The dangerous link between childhood and adulthood predictors of obesity and metabolic syndrome. *Intern Emerg Med* [Internet]. 2016 Mar 1 [cited 2023 Jun 11];11(2):175–82. Available from: <https://link.springer.com/article/10.1007/s11739-015-1382-6>
 23. Flynn AC, Suleiman F, Windsor-Aubrey H, Wolfe I, O'Keeffe M, Poston L, et al. Preventing and treating childhood overweight and obesity in children up to 5 years old: A systematic review by intervention setting. *Matern Child Nutr* [Internet]. 2022 Jul 1 [cited 2023 Jun 11];18(3):e13354. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/mcn.13354>
 24. Staniford LJ, Breckon JD, Copeland RJ, Hutchison A. Key stakeholders' perspectives towards childhood obesity treatment: A qualitative study. <http://dx.doi.org/10.1177/1367493511404722> [Internet]. 2011 Aug 31 [cited 2023 Jun 11];15(3):230–44. Available from: <https://journals.sagepub.com/doi/10.1177/1367493511404722>
 25. Sen M, Uzuner A, Akman M, Bahadır AT, Borekci NO, Viggiano E. Examination of a board game approach to children's involvement in family-based weight management vs. traditional family-based behavioral counseling in primary care. *Eur J Pediatr* [Internet]. 2018 Aug 1 [cited 2023 Jun 11];177(8):1231–8. Available from: <https://link.springer.com/article/10.1007/s00431-018-3177-z>
 26. Bass R, Eneli I. Severe childhood obesity: an under-recognised and growing health problem. *Postgrad Med J* [Internet]. 2015 Nov 1 [cited 2023 Jun 11];91(1081):639–45. Available from: <https://dx.doi.org/10.1136/postgradmedj-2014-133033>
 27. Klesges LM, Williams NA, Davis KS, Buscemi J, Kitzmann KM. External Validity Reporting in Behavioral Treatment of Childhood Obesity: A Systematic Review. *Am J Prev Med* [Internet]. 2012 Feb 1 [cited 2023 Jun 11];42(2):185–92. Available from: <http://www.ajpmonline.org/article/S0749379711008531/fulltext>
 28. Brown T, Kelly S, Summerbell C. Prevention of obesity: a review of interventions. *Obesity Reviews* [Internet]. 2007 Mar [cited 2023 Jun 11];8(SUPPL. 1):127–30. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1467-789X.2007.00331.x>
 29. Silver MP, Cronin SM. Health Care Providers' Perspectives on Family Compliance and Behavior Change in a Childhood Obesity Program. <https://doi.org/10.1177/1090198119831053> [Internet]. 2019 Feb 28 [cited 2023 Jun 11];46(4):582–91. Available from: <https://journals.sagepub.com/doi/10.1177/1090198119831053>