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(REVIEW ARTICLE)

The effects of obesity in childhood and adolescence: The role of physiotherapy: Review of reviews

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Abstract

Introduction: Obesity remains a growing global issue with its prevalence in the developed world increasing fourfold in recent decades. Childhood may represent a critical window of opportunity for intervention and prevention of long-term consequences. While physiotherapy has the practical potential to contribute to the treatment of childhood obesity, its role remains unclear due to a lack of specific guidelines.

Aim: The aim of this review is to explore the existing literature to delineate, identify and evaluate the role of physiotherapy in the management of childhood obesity

Method: A review was conducted of existing literature in 4 databases, Pubmed. Embase, Cinahl, Medline.

Results: Of the original 273 articles collected based on title and abstracts, 36 were included which were reviews. Of these, 23 were systematic reviews and 13 were literature reviews. The interventions involved quality-oriented physical activity and quantity-oriented physical activity as well as combined interventions involving different disciplines. The physical therapy interventions for children with obesity that appear to be significantly effective are: First, multi-component interventions involving environmental modification and family involvement and second, quantity-based physical activity interventions

Conclusion: Physical therapy in the treatment of children with obesity can play an important role as part of a multidisciplinary team (doctors, psychologists, teachers, trainers and others), evaluating and developing exercise programs with the ultimate goal of increasing quantitative physical activity, a practice that seems to yield the best results. Future studies should examine the impact of different rehabilitation programs depending on the individual characteristics of the children (profile, size of the problem, presence of comorbidities).

Keywords: Childhood obesity; Cardiovascular problems; Musculoskeletal problems; Interventions; Physiotherapy

1. Introduction

Obesity, according to the World Health Organization, is defined as the excessive and abnormal accumulation of fat in the body to such an extent, that the health of the individual is adversely affected (James WP, 2008). Childhood obesity has significant detrimental effects on respiratory health and quality of life, for both children and adults. Its treatment is considered imperative, as serious clinical conditions such as type II diabetes, stroke, dyslipidemia, hypertension, cardiovascular and respiratory diseases, depression and some types of cancer, have been associated with obesity (Wang Y, Monteiro C, 2002).

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Obesity, is the pandemic of the 21st century, as it affects more and more people every year. Over a billion people are obese or overweight. Unfortunately, this is a problem that also affects pediatric populations, and at many stages of their lives. In particular, data from the International Obesity Task Force indicate that approximately 22 million children, under the age of 5, are obese or overweight (Malecka-Tendera & Mazur, 2006). Childhood obesity is a public health challenge, as the rates of obese children appear to be increasing worldwide.

In Greece, overweight in children and adolescents has been an endemic problem for the last 30 years, with the rate of overweight being higher in boys than in girls, especially during adolescence. This trend also seems to affect pre-school children. Obese children have a high likelihood of developing metabolic disorders and continuing to be obese as adults. The overall health implications are serious and call for intervention programs at individual, family and national level, involving all governmental and social stakeholders (Parlapani, Tzotzas 2010; Russell SJ et al., 2023).

Obesity, as a medical problem, absorbs 2-8% of health expenditure in the European Union and is considered to be directly or indirectly related to 10-13% of deaths in different regions of Europe (Kelly AS, 2023). Greece is considered one of the countries where the problem of obesity has reached endemic proportions. Hippocrates wrote that "obesity is not just a disease, but is the harbinger of others" The vulnerable ages of children and adolescents with obesity have aroused the interest of the scientific community, as there is a plethora of health problems associated with obesity, either as causes or effects.

The causes of obesity are not fully established as both genetic and environmental factors are involved. However, the most important seems to be the influence of environmental factors such as diet, reduced mobility, psychological causes and social environment (Lee WW, 2007; Tully L et al., 2022). According to the same study the most important of all seems to be the effect of lack of exercise. The effects of childhood and adolescent obesity can be divided into direct and indirect effects on health and quality of life in general. (Zavaroni Iv, Bonora En, et al., 2010, Liese AD, Mayer-Davis EJ et al., 1998; Lister NB et al., 2023).

The direct effects include limitation of physical activity, mental strain and effects on social life. Secondary effects include insulin resistance, type II diabetes mellitus, increased cardiovascular risk, and increased incidence of respiratory and musculoskeletal problems, (Zavaroni Iv, Bonora En, et al., 2010, Liese AD, Mayer-Davis EJ et al., 1998; Kanellopoulou A et al., 2022).

Over the last 20 years, our way of life has changed significantly and this is also affecting younger generations. Instead of playing outside, running around and exercising all the time, children are glued to a TV and computer screen. Childhood obesity, is linked to some serious health complications. Notably, watching TV is associated with the simultaneous consumption of unhealthy foods such as snacks or sweets. Based on studies, television advertisements are associated with an increase in children's desire to consume these foods, which leads to the development of childhood obesity (Ruiz LD et al., 2020; Jebeile H et al., 2022).

Psychosocial consequences, which are often underestimated, are common and include low self-esteem, anxiety, depression and poor quality of life. In a study by Schwimmer JB, Burwinkle TM et al, (2003), it was found that the quality of life of obese children and adolescents, particularly those with obstructive sleep apnea syndrome, was affected to a similar extent to the quality of life of children and adolescents who had been diagnosed with cancer, a finding that indicates the severity of the problem and the impact it can have on the child's overall personality development.

The problems that children with obesity have and are related to physical therapy, are mainly found in two systems: the respiratory and the musculoskeletal system. In particular, children with obesity have a significantly higher incidence of obstructive apnea syndrome (Narag I, Mathew JL, 2012), may experience alveolar hypoventilation associated with a severe reduction in oxygen saturation (Verhulst SL, Schrauwen N, 2007; Russell SJ et al., 2023) and a higher incidence of bronchial asthma (Papoutsakis C., Priftis KN, 2013; Apperley LJ et al., 2022).

The most common musculoskeletal problems are: reduced mobility, joint pain, especially of the spine and lower limbs, deformities, etc. (Pomeratz WJ, TimmNL, 2010), (Chan G., Chen CT, 2009). One of the most important risks in cases of severe obesity, is epiphysiolysis of the femoral head (Chan G, Chen CT, 2009; Förster LJ et al., 2023).

Standard interventions in childhood obesity are based on the philosophy of energy balance (Sahoo K, Sahoo B, 2015). Based on this theory if energy intake is greater than consumption this results in fat accumulation. Therefore, common approaches to control obesity include either reducing energy intake through diet or increasing energy expenditure through physical activity (Nga VT, Dung VNT,2019; Lonkhuyzen ML et al., 2023; Truong K et al., 2021).

However, Flatt et al., (2011) emphasise that the management of obesity is not simple, but must be multifactorial in nature. Due to its complexity obesity requires multi-faceted intervention by a multi-disciplinary team, practice which appears to be the most effective (Al-Khudairy L, Loveman E, 2017, Colquitt JL, Loveman E, 2016; Woolford SJ et al., 2021). Unfortunately, many times obesity is treated in ways that are not in line with the needs of the individual and are aimed solely at weight reduction rather than educating a different lifestyle. Therefore, it seems appropriate to replicate these studies to determine the value of the proposed practices (Rajjo T, Mohammed K, 2017).

Faigenbaum et al., (2013) discussed the need for experienced pediatric professionals to practice developmentally appropriate physical activities and emphasize the unique physical and psychological needs of children. Physical therapists are ideally best suited to implement such programs, however the field of pediatric physical therapy itself should determine the need for the creation of a discipline that specifically addresses childhood obesity (Milne N, Choy NL, 2016; Murphy 2022; Tung JYL, 2023; Nicolucci A et al., 2022; Kansra AR, et al., 2021).

This review provides data on the value of physical therapy in the treatment of childhood obesity, which may increase physical therapists' engagement with this important clinical entity and guide them in implementing evidence-based programs.

2. Methodology

The literature search was performed in five databases: PubMed, Embase, CINHAL, and Medline. The initial selection of articles was based on the title and abstract using the selection/exclusion criteria as listed in the table below (tabl. 1).

Table 1 Study selection/exclusion criteria

Inclusion Criteria	**Exclusion Criteria**
Children and adolescents with overweight/obesity	Animal studies
The management/intervention used in the article can be physical, behavioral, nutritional, or educational (or a combination of all).	Studies where no interventions are proposed (profile studies)
The intervention used in the article must be practicable by a physiotherapist or should be possible to be implemented by a physiotherapist depending on the context (e.g., school physical education programs, physical activity programs given by doctors).	Unavailable full articles (e.g., abstracts or posters, source not available)
Articles must be in English	
Studies should concern reviews that refer to obesity management/intervention.	

3. Results

From the database search, 36 articles were ultimately selected and are presented in the flow chart (Fig.1) and table below (tab. 2), by region, age, intervention method and outcomes.

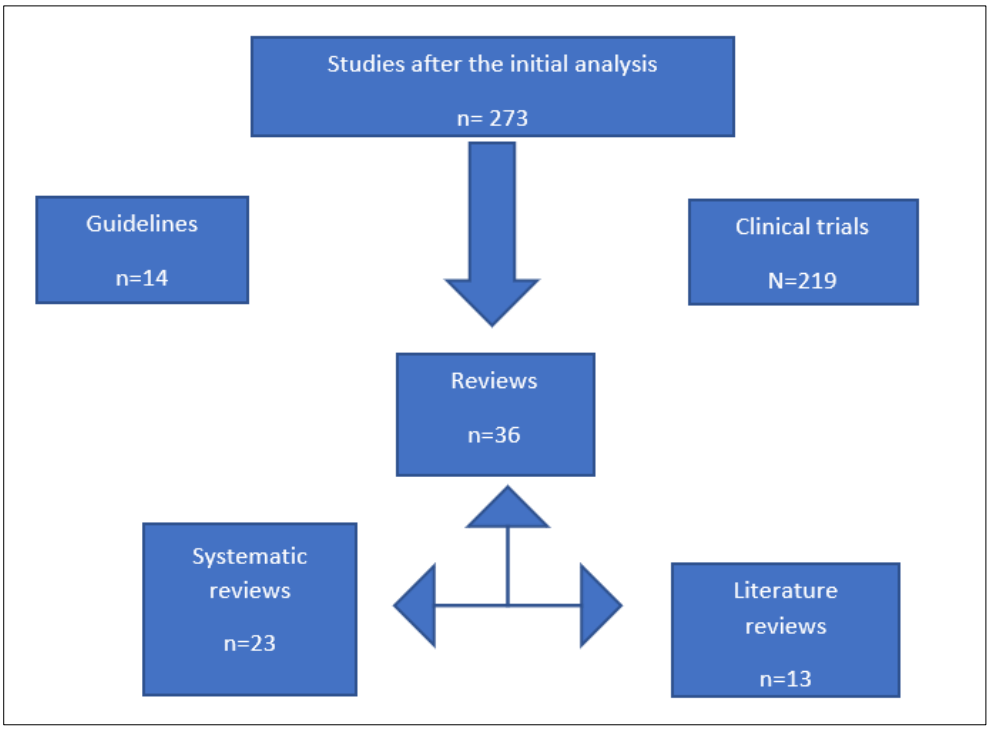

Figure 1 Flow chart

Table 2 Studies

36 reviews	
Publication dates: 2005 – 2023	
	Ranking of studies according to publication date
2005	Stuart WP, Broome ME, Smith BA, Weaver M, 2005. An integrative review of interventions for adolescent weight loss
2006	Atlantis E, Barnes EH, et al. 2006. Efficacy of exercise for treating overweight in children and adolescents: a systematic review Garcia-Hermoso A, Ramirez-Velez R, et al. 2006. Exercise, health outcomes, and pediatric obesity: A systematic review of meta-analyses Doak CM, Visscher TL, et al. 2006. The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes
2007	Salmon J, Booth ML, Phongsavan P, Murphy N, Timperio A, 2007. Promoting physical activity participation among children and adolescents
2008	Clark ML, Slemmons M, 2008. School programs to reduce the prevalence of obesity in children
2009	Zenzen W, Kridli S, 2009. Integrative review of school-based childhood obesity prevention programs Harris KC, Kuramoto LK, et al. 2009. Effect of school-based physical activity interventions on body mass index in children: a meta-analysis
2011	De Bourdeaudhuij I, Van Cauwenberghe E, et al. 2011. Schoolbased interventions promoting both physical activity and healthy eating in Europe: a systematic review within the HOPE project

2012	Niemeier BS, Hektner JM, et al. 2012. Parent participation in weight-related health interventions for children and adolescents: a systematic review and meta-analysis
2013	Sun C, Pezic A, 2013. Effects of school-based interventions for direct delivery of physical activity on fitness and cardiometabolic markers in children and adolescents: a systematic review of randomized controlled trials. Lobelo F, Garcia de Quevedo I, et al. 2013. School-based programs aimed at the prevention and treatment of obesity: evidence-based interventions for youth in Latin America
2014	Vasconcellos F, Seabra A, et al. 2014. Physical activity in overweight and obese adolescents: systematic review of the effects on physical fitness components and cardiovascular risk factors
2015	Dias KA, Green DJ, et al. 2015. Exercise and Vascular Function in Child Obesity: A Meta-Analysis
2016	Brown EC, Buchan DS, et al. 2016. A Systematised Review of Primary School Whole Class Child Obesity Interventions: Effectiveness, Characteristics, and Strategies Guerra PH, da Silveira JA, et al. 2016. Physical activity and nutrition education at the school environment aimed at preventing childhood obesity: evidence from systematic reviews Garcia-Hermoso A, Sanchez-Lopez M, et al. 2016 Exercise based interventions and C-reactive protein in overweight and obese youths: a meta-analysis of randomized controlled trials
2017	Feng L, Wei DM, et al. 2017. Systematic review and meta-analysis of school-based obesity interventions in mainland China
2018	Han A, Fu A, et al. 2018. Effectiveness of exercise intervention on improving fundamental movement skills and motor coordination in overweight/obese children and adolescents: A systematic review Craike M, Wiesner G, et al. 2018. Interventions to improve physical activity among socioeconomically disadvantaged groups: an umbrella review Engel AC, Broderick CR, et al. 2018. Exploring the Relationship Between Fundamental Motor Skill Interventions and Physical Activity Levels in Children: A Systematic Review and Meta-analysis Errisuriz VL, Golaszewski NM et al. 2018. Systematic Review of Physical Education Based Physical Activity Interventions Among Elementary School Children
2019	Delgado-Floody P, Latorre-Roman P, Jerez-Mayorga D, Caamano-Navarrete F, Garcia-Pinillos F. 2019. Feasibility of incorporating high-intensity interval training into physical education programs to improve body composition and cardiorespiratory capacity of overweight and obese children: A systematic review Garcia-Hermoso A, Cerrillo-Urbina AJ, et al. 2019. Is high-intensity interval training more effective on improving cardiometabolic risk and aerobic capacity than other forms of exercise in overweight and obese youth? A meta-analysis Andrade A, Correia CK, et al. 2019. The Psychological Effects of Exergames for Children and Adolescents with Obesity: A Systematic Review and Meta-Analysis Oliveira CB, Pinto RZ, et al. 2019. Effects of active videogames on children and adolescents: a systematic review and meta-analysis
2020	Rehana A. Salam, et al. 2020. Efects of Lifestyle Modification Interventions toPrevent and Manage Child and Adolescent Obesity: A Systematic Review and Meta-Analysis, Nutrients 2020, 12, 2208; doi:10.3390/nu12082208

	Yuksel HS, Şahin FN, et al. 2020. School-Based Intervention Programs for Preventing Obesity and Promoting Physical Activity and Fitness: A Systematic Review Morgan EH, Schoonees A, Sriram U, Faure M, Seguin-Fowler RA. 2020. Caregiver involvement in interventions for improving children's dietary intake and physical activity behaviors
2022	Calcaterra V, Marin L, et al. 2022. Childhood obesity and incorrect body posture Calcaterra V, Vandoni M, et al. 2022. Use of Physical Activity and Exercise to reduce inflammation in children and adolescents with obesity Wang W, Cheng J, et al. 2022. The effectiveness of Wearable devices as physical activity interventions for preventing and treating obesity in children and adolescents: systematic review and meta-analysis Logan N.E, Ward- Ritacco Ch, 2022. The developing brain: considering the multifactorial effects of obesity, physical activity & mental wellbeing Tully L, Arthurs N, 2022. Guidelines for treating child and adolescent obesity:A systematic review
2023	Obita G, Alkhtib Ab, 2023. Interventions for childhood obesity and associated comorbidities among children from minority ethnic groups: a systematic review and meta-analyses Denova-Gutierezz Ed, Gonzalez- Rocha Al, et al. 2023. Overview of Systematic Reviews of Health Interventions for Prevention and Treatment of Overweight and Obesity in Children
Interventions:	Studies
School-based nutrition/physical activity interventions	Brown EC, et al. 2016. Clark ML, et al. 2008. De Bourdeaudhuij I, 2011. ErrisurizVL,et al. 2018. Feng L, et al. 2017. Lobelo F, et al. 2013. Zenzen W, et al. 2009. Denova-Gutierezz Ed et al. 2023
Exercise only	Atlantis E, et al. 2006. Craike M, et al. 2018. Dias KA, et al. 2015. G.Hermoso et al. 2019. G.-Hermoso et al. 2016.
High intensity interval training	Delgado-Floody P, et al. (2019) G.-Hermoso et al. 2016.
Weight loss	Guerra PH., et al. 2016. Stuart WP, et al. 2005. Sun C., et al. 2013.
Structural motor activities	Doak CM., et al. 2006. Engel AC., et al. 2018. Han A, et al. 2018. Calcaterra V et al. 2022

Physical activities	Harris KC, et al. 2009. Salmon J, et al. 2007. Vasconcellos F, et al. 2014. Denova-Gutierezz Ed. 2023 Tully L. 2022
Activity through online games	Oliveira CB, et al. 2019. Andrade A, et al. 2019.
Activity through wearable devices	Wang W. et al. 2022
Exercises with parental participation	
School prevention programs	Doak CM, et al. 2006. Salmon J, et al. 2007. Yuksel HS, 2020.
Results:	Studies
Improving anthropometric parameters	Brown EC, et al. 2016. Clark 2008. De Bourdeaudhuij, 2011. Delgado-Floody P et al. 2019. Dias KA, et al. 2015. Doak CM, 2006. Errisuriz VL, 2018. Garcia-Hermoso 2019. Han A, Fu A, et al. 2018. Wang W. et al. 2022 Denova-Gutierezz Ed. 2023
Improving physical fitness	Craike M, et al. 2018. Engel AC, et al. 2018. Feng L, et al. 2017. Calcattera V et al. 2022
Improving health parameters (cardiovascular system, musculoskeletal system e.t.c)	Calcattera V et al. 2022

Based on the above results, improvement in anthropometric parameters (weight) was observed in 11 studies, 4 of which involved school interventions with nutrition/physical activity programs, one involved a high-intensity interval training program, 3 involved simple exercise, one involved integration in physical activities, one involved school-based prevention programs and one involved activities through wearable devices

Improvements in physical fitness were observed in 4 studies of which one involved simple exercise, 2 after a program of structural movement activities and one after a school-based nutrition/physical activity intervention program.

Study limitations

Although this study examined a large number of reviews, the review of the articles and the decision to include or exclude based on the title and abstract was made by a single researcher limiting reliability. The lack of quantitative and qualitative analysis of the data is also a major limitation. Further review studies are needed involving a larger number of researchers.

4. Discussion

The purpose of this review was to explore the existing literature on the effectiveness of physiotherapy and related interventions in the treatment of childhood obesity.

The key finding of the review, hypothesizes that the amount of physical activity causes desirable changes in health parameters (strength, coordination, cardiorespiratory performance), while multisystemic interventions (interventions involving different disciplines such as physicians, nutritionists, psychologists, physiotherapists, parents, etc.), facilitate the achievement of desirable changes in behavioral measures (adoption of healthier lifestyles).

The important impact of multidisciplinary collaboration is also highlighted in the official World Health Organization guidelines on nutrition, physical activity and health (Yuksel HS, Şahin FN, et al. 2020). The World Health Organization's notes on the threat of diseases such as obesity, governments recommended that research be conducted with intervention programs aimed at improving nutrition and/or physical activity (Yuksel HS, Şahin FN, et al. 2020).

The study of the multisystem approaches showed that although they did not significantly improve anthropometric measures, they did bring about significant changes in physical activity, behavior, and self-esteem. According to the International Institute for Health and Clinical Excellence guidelines, it is recommended that interventions to address childhood obesity should not focus on weight but on strategies to adopt healthier habits (increasing activity and improving eating habits) in order to improve or/and prevent, important health parameters (De Bourdeaudhuij I, Van Cauwenberghe E, et al. 2011, Garcia-Hermoso A, Sanchez-Lopez M, et al. 2016).

The environment plays an important role in both the prevention and treatment of childhood obesity. The home environment and parental influence play a more important role. The type and availability of food in the home, parental behavior, their own habits and beliefs have perhaps the most important influence on the risk of obesity (Stuart WP, Broome ME, et al. 2005). Despite the benefits of a family-focused intervention, qualitative analyses suggest that various parental concerns may act as an inhibitor to addressing childhood obesity (fear of negative stereotyping in society and support for 'diversity').

Some parents believe that any intervention may create a child's belief that their body is "undesirable" and negatively affect their cognitive and emotional health (Stuart WP, Broome ME, et.al. 2005). The results of these studies showed that systematic interventions create positive changes in self-esteem by improving physical appearance, increasing participation in fun activities, and increasing sociability.

Physiotherapy has a dynamic role to play in the treatment of childhood obesity as the most appropriate science for reporting physical activity and exercise and understanding the difficulties that can affect the ability to achieve positive change. Collaboration with school fitness instructors to develop quality programs in schools, is very important (De Bourdeaudhuij I, Van Cauwenberghe E, et al. 2011). Physiotherapy treatment through a holistic approach aimed at preventing, assessing and treating motor difficulties or improving function, appears to be one of the most essential parameters for the success of a program (Atlantis E, Barnes EH, et al. 2006). Childhood obesity, is a broad area of investigation by physiotherapists in order to determine the most appropriate programs according to age and problem.

5. Conclusion

As the review of reviews on the impact of physiotherapy and exercise on the treatment of childhood obesity shows, the involvement of physiotherapists in scientific intervention teams is essential, appropriate and effective.

The application of physiotherapy methods appears to have a significant effect on health indicators and overall motor behavior in obese children, however, further clinical trials are recommended to determine the type of intervention according to age, abilities and personality profile to enable physiotherapists to proceed with the implementation of the most appropriate and personalized intervention programs.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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