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Childhood Overweight and Obesity: Affecting Factors, Education and Intervention

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Abstract

Overweight and obesity is a global epidemic among children of all ages. Pre- and primary school children who are overweight and obese are more likely to continue to be obese as adolescents and adults, as well as stand at an increased risk for poor health outcomes associated with excess weight. While the central physical cause of overweightness and obesity is the imbalance of energy intake from food and energy expended through physical activity, excess weight is also caused by a number of other contributory factors including personal, social, and environmental influences. Among school-aged children, there seems to be substantial interest and resources currently being devoted to primary and secondary prevention, though intervention studies have yielded somewhat mixed results. Education, interventions, and evaluations of the effectiveness and outcomes of new initiatives aiming to reduce childhood overweight and obesity are needed to recommend future programs with the greatest likelihood of success.

Centers for Disease Control and Prevention (CDC), prevalence of obesity in US youth was 18.5% in 2015-2016 [3].

Numerous efforts have been put forth to combat childhood overweight and obesity, including standards, goals and objectives, as well as various initiatives. National Health Education Standards (NHES) authored by the Joint Committee on National Health Education Standards from the CDC were developed to establish, promote, and support health-enhancing behaviors in all grade levels. Nutrition, physical activity, and obesity have been embedded in the Office of Disease Prevention and Health Promotion's Healthy People priority areas, goals, and objectives since the program's inception. A subcommittee of the President's Council on Fitness, Sports & Nutrition, sanctioned by the Department of Health and Human Services (HHS), has also made recommendations based on its Physical Activity Guidelines for Americans Midcourse Report: Strategies to Increase Physical Activity Among Youth [4] that school settings should serve as an essential component of a national strategy to increase physical activity, along with preschool and childcare center settings providing increased physical activity opportunities. Aside from the aforementioned standards, goals and objectives, and recommendations, additional national standards related to preventing childhood obesity in early care and education programs have also been promoted. These selected standards were taken from *Caring for Our Children: National Health and Safety Performance Standards; Guidelines for Early Care and Education Programs, Third Edition (CFOC3)* [5]. In addition, these latter standards support key national campaigns for early development of healthy habits including Let's Move! [6]. All of these intervention efforts have had mixed results thus far.

Keywords: Childhood overweight; Obesity; Children; Nutrition; Physical activity

Introduction

Overweight and obesity is a global epidemic among children of all ages. According to the World Health Organization (WHO), the prevalence of combined overweight and obesity in children rose by 47.1% between 1980 and 2013. In 2014, an estimated 41 million children under the age of five years were affected by overweight and obesity [1]. Childhood obesity in the United States (US) is a serious problem. In a nationally representative study of US children and adolescents aged 2-19 years, the prevalence of obesity was estimated at 17% in 2011-2014; extreme obesity was 5.8% [2]. According to the most recent National Center for Health Statistics (NCHS) Data Brief from the

This qualitative review summarizes the current scientific literature on childhood overweight and obesity including trends and its effects on child and adolescent health, examines current intervention efforts, as well as makes recommendations to combat this serious public health issue in the near future. The review will include: factors affecting childhood overweight and obesity, related barriers to behavioral change, and educational needs of children. Also, it will examine a number of current

intervention methods and discuss the recommendation of more comprehensive educational- and intervention-based measures.

Childhood Overweight and Obesity Trends in the United States

The prevalence of obesity and overweightness, defined as a body mass index (BMI) at or above the 85th percentile, has continued to increase despite national intervention goals. Specifically, obesity is defined as having a BMI at or above the 95th percentile on the basis of weight and height for persons of the same age and sex. Aside from the most recent overall statistic of 18.5% of US youth being obese, the prevalence of obesity in adolescents (20.6%) and school-aged children (18.4%) was higher than among preschool-aged children (13.9%). Further, school-aged boys (20.4%) had a higher prevalence of obesity than preschool-aged boys (14.3%); adolescent girls (20.9%) had a higher prevalence of obesity than preschool-aged girls (13.5%). Aside from a slight decrease from 2003-2004 (17.1%) to 2005-2006 (15.4%) and a plateau from 2009-2010 to 2011-2012 (16.9%), the overall trend in obesity prevalence among youth aged 2-19 years has increased from 13.9% in 1999-2000 to 18.5% in 2015-2016 [3].

The overweight and obesity epidemic is disproportionately higher in children from low-income and education, and higher unemployment households. Populations experiencing rapid socioeconomic and/or nutritional transitions appear to be at particular risk [1]. In addition, while the majority cultures in numerous regions of the United States place a value on their children being within the normal weight ranges, minority cultures and other regions do not necessarily value a healthy body weight. However, individuals from all socioeconomic groups, educational levels, regions, and cultures have a vested interest in developing educational and behavioral interventions to control childhood overweight and obesity in efforts to minimize the negative consequences on children and adolescent health outcomes.

Effects of Overweight and Obesity on Child and Adolescent Health

Pre- and primary school children who are overweight and obese are more likely to continue to be obese as adolescents and adults, as well as stand at an increased risk for poor health outcomes associated with excess weight. Such conditions related to obesity include asthma, diabetes, cardiovascular disease, and sleep apnea [7,8]. Cardiovascular disease risk factors in the form of elevated total cholesterol, triglycerides, insulin levels, and increased blood pressure were found in 60% of obese children aged 5-10 years [7]. The health-related quality of life in obese children is so poor that it is similar to that of children with cancer, in comparison to healthy children [9].

Due to the increased likelihood that overweightness and obesity in early childhood often continues in adolescence and adulthood, it is imperative that parents, caregivers, educators, and all those who tend to children play an active, instrumental role in preventing overweight and obesity in children. The

prevention of such is central to improving lifelong health outcomes, as obesity is associated with reduced overall adult life expectancy [10]. Furthermore, the physical health risks of obesity are not isolated. The stigma associated with childhood overweight and obesity also carries a risk for psychological and social problems related to negative self-image and low self-esteem [11]. Intervention efforts need to address both the physical and emotional consequences of obesity.

Childhood Overweight and Obesity: Affecting Factors

The central physical cause of overweightness and obesity is the imbalance of energy intake from food and energy expended through physical activity. This physical problem is most often the causal factor studied in childhood obesity. However, excess weight is also caused by a number of other contributory factors including personal, social, and environmental influences that pose more challenges in terms of understanding, measurement, and change. Personal characteristics and behaviors can negatively impact a child's weight, mental health, and sleep. Social and environmental factors include those influences in the home, school, community, and society. For instance, family and friends influence and support one's lifestyle and daily habits; schools are seemingly providing fewer opportunities for physical activity, due to a greater emphasis on academic achievement; and environmental factors including community resources and even media in society are sending conflicting messages concerning a healthy lifestyle.

Scientific research has identified a number of components that may contribute to childhood overweightness and obesity. Among these components, the following will be examined more closely in the upcoming discussion: (1) nutrition, (2) physical activity, (3) mental health and mood, (4) sleep hygiene, and (5) media usage.

Nutrition

Nutrition is paramount to healthy growth and development, as well as disease prevention during childhood. However, Healthy People 2020 data indicated that the national goals for nutrition in childhood have not been met thus far. Between 2008 and 2015, food insecurity in US households fluctuated between 14.6 to 12.7%, which signaled an improvement, but missing the Healthy People 2020 target of 6% [12]. Between 2005-2008 and 2009-2012, there was no change in mean daily fruit or vegetable consumption of individuals aged two years and older. Research accounted for the mean daily intake of fruits 0.53 cup equivalent per 1,000 calories (2005-2008) and 0.53 (2009-2012), with a Healthy People 2020 target of 0.93 cup [13]; mean daily intake of vegetable consumption of individuals aged two years and older. Research accounted for 0.76 cup equivalents of total vegetables per 1,000 calories in 2005-2008 and 0.76 in 2011-2014, with a Healthy People 2020 target of 1.16 cup equivalents per 1,000 calories [14]. In terms of healthier food access for children and adolescents, 24 states had nutrition standards for foods and beverages provided to preschool-aged children in child care compared to Healthy People 2020 target of

34 states; however, the schools that did not sell or offer calorically sweetened beverages to students rose from 9.3% in 2006 to 25.6 in 2014 (Healthy People 2020 target 21.3%), and 9.6% of school districts required schools to make fruits or vegetables available with the offering of other food in 2006 (Healthy People 2020 target 18.6% states) [15,16].

Nutritional practices of school-aged children are influenced by the nutrition education provided in schools. In comparing data from the last 2 years' (2016-2017) national surveys, the School Health Policies and Programs Study (SHPPS) overviews reported that among the schools providing nutrition and dietary behavior, the elementary and middle school levels all increased from 68.9% to 70.6% (elementary schools: 2016-2017) and 75.1% to 76.9% (middle schools: 2016-2017), though the number of high schools teaching nutrition and dietary behavior actually decreased from 85.9% in 2016 to 84.6 in 2017 of high schools were required to teach about nutrition [17]. The SHPPS further reported nutrition and dietary behavior practice health education trends over 2000-2014 decreased from 84.6% (2000), to 84.3% (2006), to 74.1% (2014) [18].

Physical activity

Physical activity (PA) is defined as structured or unstructured movement through a variety of moderate- or vigorous-intensity activities that promotes fitness and substantial health benefits [19]. PA in childhood is associated with physical and mental health, and may prevent the early onset of risk factors for several chronic diseases that manifest later in life [20-22]. However, evidence suggests that the majority of children are not sufficiently active which supports the need for intervention programs increasing childhood PA levels [23,24]. Aside from minimizing the risks for chronic disease and premature death, regular PA also assists in weight control, improves strength and endurance, builds healthy bones and muscles, reduces stress, and increases self-esteem in children and adolescents [19]. More importantly, it has been suggested that there may be a behavioral carryover into adolescence and adulthood, whereby active children are more likely to continue engaging in PA as they grow older [23]. However, levels of PA in childhood have decreased in recent years, which has been associated with an increased focus on academic achievement in schools and increased use of electronic media.

The obesity epidemic is related to lower levels of PA among children in comparison with the evidence-based recommendations. According to the 2008 Physical Activity Guidelines for Americans, children and adolescents aged 6-17 years should be physically active 60 minutes or longer every day. Included in these 60-minute PA guidelines are moderate to vigorous aerobic activity contributing the most to the 60 minutes, including vigorous PA at least three days a week; as well as muscle- and bone-strengthening PA, each on at least three days of the week. It is also stressed that children and adolescents are encouraged to participate in a variety of physical activities that are age- and developmentally-appropriate, enjoyable, and fun [19].

Studies have indicated that levels of total energy expenditure and PA levels in pre-school children are very low [25-27]. The

2011 National Youth Risk Behavior Survey (YRBS) reported that youth are not getting the recommended 60 minutes of daily PA; research shows that 29% of high school students are physically active for one hour or more during a seven-day period, while 14% are not participating in any type of PA on any day during a seven-day period [4]. It has been suggested that school-aged children have three distinct opportunities to be physically active: physical education (PE), recess/lunch, and outside of (either before or after) school. Each of these times' are considered to contribute to overall PA, with the school environment perceived to provide the richest opportunities [28]. However, SHPPS data from 2014 [18] indicated that the school venue had not fared so well in this respect. For PE, 3.6% of elementary schools, 3.4% of middle schools, and 4.0% of high schools required daily PE or its equivalent (150 minutes per week in elementary schools and 225 minutes per week in middle and high schools) for the entire school year (36 weeks) for students in all grades in the school. In regards to daily recess, it was provided in 82.8% of elementary schools for students in all grades in the school. Intramural sports programs or PA clubs were offered to students by 54.7% of schools; and 26.5% of elementary schools, 84.8% of middle schools, and 94.1% of high schools offered students opportunities to participate in interscholastic sports [17]. According to SHPPS trend data for 2000-2014, PE was reported to have decreased trends. Schools with a PE requirement for students' promotion to the next grade or school level or graduation declined from 96.4% (2000) to 78.4% (2006) to 76.5% (2014). Schools requiring PE in a specific grade also exhibited a decreased trend from (2000 data not available) 62.6% (2006) to 52.1% [18]. PA opportunities in schools also decreased: all classes with a regularly scheduled recess immediately after lunch fluctuated, but resulted in a decline with 42.3% (2000) to 49.6 (2006) to 26.2 (2014); and the offering of community PA programs for children and adolescents after school declined from 63.8% (2000) to 56.5% (2006) to 52.6% (2014). However, the offering of specific PA clubs or intramural sports programs for students resulted in increased trends for cardiovascular fitness (11.4% in 2000; 22.9% in 2006; 23.1% in 2014) and walking (12.1% in 2000; 19.8% in 2006, 22.4% in 2014) [18]. CDC data from 2013 reported that 27.1% of adolescents were physically active on a daily basis, with 29.4% participating in daily PE [18]. The WHO [1] found that approximately 81% of adolescents do not achieve the recommended 60 minutes of daily PA.

Mental health and mood

The mental health status of children is closely associated with healthy behaviors affecting obesity, including eating patterns, PA, and interest in participation in activities. Studies have reported that psychological and mood disorders have been linked to weight problems and obesity in children and adolescents. Depression and anxiety were found to be associated with an increased BMI among those aged 8-18 years, compared with healthy children [29]. Another study reported that the risk for major depressive or anxiety disorder increased four times over 20 years among women who were obese as adolescents [20]. Further, a study of more than 13,000 adolescents exhibited a strong association between self-

perceived weight and depressive symptoms [30]. This particular study highlights the importance of weight stigmatization in society and the effect that self-perception of obesity has on children's mental health.

Studies have shown that mental stress has also been shown to affect weight. Family stress was associated with child overweightness and obesity. The types of stress implicated in obesity among young children (ages 5-11) included lack of cognitive stimulation and emotional support. For older children (ages 12-17), stress related to obesity included mental health problems, physical health problems, and financial strain in the home [31]. This research indicated the importance of reducing stress as a potential factor in combatting childhood obesity.

Sleep hygiene

Inadequate sleep is associated with obesity and is considered to be a modifiable risk factor [32]. The 2007 National Survey of Children's Health (NSCH) showed that 17 million children in the US 6-17 years of age do not get adequate sleep [33]. In another study of children and adolescents, short durations of nighttime sleep in children up to four years of age was related to an approximate two-fold increased risk for overweight and obesity [34]. This study indicated that adequate sleep in infancy and the preschool years may decrease the risk for childhood obesity. Additionally, a combination of having adequate nighttime sleep, eating the evening meal with the family, and limiting screen-viewing time for preschool-aged children was associated with a 40% lower prevalence of obesity [35]. Early childhood studies reported that lifestyle factors associated with childhood obesity include inadequate sleep in infancy [36].

Adequate sleep is also very important for adolescents, and may be related to obesity. One study of more than 8,000 students in 40 schools reported lifestyle factors associated with obesity in 13-16 year olds [37]. Liou et al. also found that sleeping less than 7.75 hours per day on the weekend was associated with a four-fold increased risk for obesity in girls and a 1.6-fold increased risk in boys. Another study found that obstructive sleep apnea in children 12 years of age or older was linked with obesity, with a more than three-fold increased incidence with every standard deviation increase in BMI [38].

Media usage

Media use was first identified as a strong correlate of childhood overweight and obesity in the 1980s, and has been supported by numerous studies since that time [39]. As media devices evolve, researchers have become more interested in the links between emerging media types and childhood overweight and obesity. Early research focused on television viewing, and that is still the medium with which the most American children spend the greatest number of hours. Recent surveys have indicated that school-age children spend an average of three hours per day watching television, and their time with screen media increases to more than five hours per day when computers and video games are included [40]. While there have been mixed results in the examination of television, gaming, computer, and smartphone usage [41], multiple cross sectional

surveys have suggested that as the number of hours of media usage increases, body fat percentage and the risk of overweight also increases in a dose-response manner [42-45]. The reasons for which have been proposed based on a lower resting energy expenditure, displacement of PA, food advertising leading to increased energy intake, and eating while viewing leading to greater energy intake [40].

Childhood Overweight and Obesity: Additional Barriers to Behavior Change

There are various barriers that impede the progress of reversing the overweight and obesity trend. In addition to the challenges embedded in the five factors discussed in the previous section, there are also a number of environmental barriers. One of which is healthcare. In some circumstances, healthcare may create barriers to the prevention of childhood obesity rather than promoting change. One survey of 677 primary practice clinicians reported that only half currently assess BMI percentile for children in their practices. Additionally, most surveyed clinicians believed that they should be actively involved in preventing obesity in children, but reported that counseling produced poor results and/or they did not have the time to provide that information and support [46]. There is also the issue of lack of health insurance coverage in the screening and treatment of childhood overweightness and obesity in most states. Though state legislation in this category generally requires private insurers, public insurance programs such as Medicaid or State Children's Health Insurance Programs (SCHIP), or state employee health insurance programs can also provide or strengthen obesity health insurance coverage. State legislation in this category does not always specifically refer to childhood obesity, and private insurance companies may or may not include children. It seems that nearly all states do not explicitly include coverage for obesity prevention and treatment for children with the exception of one state. Maryland seems to be the only state with a law requiring insurance coverage for obesity evaluation and management as a child wellness service; it was enacted in 2010 [47].

Socio-economic barriers also pose challenges to behavioral change in overweight and obesity. Disadvantaged youth are more likely to be overweight and obese in adolescence and during the transition to adulthood. A study of the National Longitudinal Study of Adolescent Health found that poverty in childhood affected obesity in adolescent girls. Additionally, neighborhood poverty and low parental education were related to obesity in both boys and girls [48].

Childhood Overweight and Obesity: Education and Intervention

Due to the fact that all share in the consequences of overweight and obesity on the health outcomes of children and adolescents, educational and policy- and practice-based interventions required must reach across all regions, cultures, healthcare coverage systems, and socio-economical levels to reach those individuals with the greatest needs. Further, the

stakeholders in reducing childhood overweight and obesity include not only children and adolescents, but also parents; caregivers; schools; early care and education providers; healthcare professionals; community and business leaders; state and local officials; and society, as a whole. Educational needs include improving awareness of nutritional guidelines and needs, providing tools and resources, attempting to facilitate healthier behavior, as well as ensuring access to healthy foods. In addition to education, policy- and practice-based interventions related to the inclusion of resources and support in schools and communities for PA, mental health and mood, and good sleep hygiene are needed. Furthermore, each of these interrelated areas of educational and intervention-based needs must span individual, family, school, and community settings in society.

The Healthy People 2020 goals and objectives include many measures to address childhood overweight and obesity: limiting weight gain, increasing the prevalence of BMI measurement conducted by physicians, providing incentives to food stores to provide foods that meet dietary guidelines, and improving the nutritional standards of food and beverages in schools. Additionally, the CDC recently recommended community strategies related to improving nutrition and PA, with the goals of childhood obesity prevention [49].

Among school-aged children, there seems to be substantial interest and resources currently being devoted to primary and secondary prevention, though intervention studies have yielded somewhat mixed results. The settings for many of these studies have included the home, school, clinic, and/or community. Aside from data collection taking place in different trials and meta-analytic protocols, the results of which have been conflicting. A fair amount of research on incorporating PA into the classroom, including in the curricula, has yielded positive results. Donnelly et al. introduced Physical Activity across the Curriculum (PAAC) interventional programming that suggested such activities could minimize increases in BMI [50]. Other research reviewing the effects of similar programming entitled 'TAKE 10', also indicated the potential positive impact on BMI [51]. However, while these studies suggest that various school-based interventions have been effective in lowering children's and adolescents' BMI, some research including a meta-analysis of 38 combined PA and nutrition education school-based interventions has not [52-54]. A more recent meta-analysis of school-based obesity prevention including nutrition, PA, parental involvement, and/or specialist involvement indicated that among the 27 programs researched, there were no significant findings suggesting that these school-based interventions were effective [55]. Among the 'home and school' and 'school' only settings, another meta-analysis indicated that 11 studies were deemed effective and 12 ineffective. The majority of the reported interventions for both the effective and ineffective studies in the 'home and school' and 'school' settings consisted of nutrition only; PE only; PE and compulsory PA; and nutrition and PE, and voluntary PA [56]. Other studies have also included sleep duration and/or screen time [55,57-59].

Education, interventions, and evaluations of the effectiveness and outcomes of new initiatives aiming to reduce childhood

overweight and obesity are needed to recommend future programs with the greatest likelihood of success. In fact, the Commission on Ending Childhood Obesity (ECHO) recently presented its final report to the WHO and included were recommendations to implement comprehensive programs that provide guidance on and support for healthy diet, sleep, and PA in early childhood to ensure proper growth and development of healthy habits, as well as comprehensive programs that promote healthy school environments, health and nutrition literacy and PA in school-age children and adolescents, and provide family-based, multi-component, lifestyle weight management services for children who are obese [60]. Based on these specific recommendations, interventions might be more inclusive to combine components such as nutrition, PA, PE, mental health and mood, sleep hygiene, and media usage. Additional settings in which these interventions should be implemented could also include home, child care, school, healthcare, and community. To date, research has not yielded any such comprehensive combination of interventions in multiple settings.

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