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Obesity, Overweight and Underweight among Children in South Iran: Prevalence, Trends (2011-2016-2021) and Associated Risk Factors from Repeated Cross-Sectional Surveys

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Abstract

Background and purpose: A study involving children of Bushehr (South Iran) demonstrates that as a result of a marginal decline in the prevalence of underweight between 2011 and 2021 12.2% to 11.78 %), alongside with a fundamental upsurge in the prevalence of overweight (11.6% Up to 18.91%) and an gradual increase in obesity which was 10.9% in 2011 to 15.80% in 2021. The outbreak of these three diseases in 2016 was very close. If these trends were maintained stable, it is very likely that at this time, the prevalence of childhood overweight has not already exceeded that of underweight based on the current examination. Even though, no study is available to confirm this hypothesis. Identifying these changes is related to planning and evaluating public policies. The aim of this study was to investigate the prevalence, time course and factors associated with obesity and overweight as well as underweight in Bushehr children.

Methods: Independent cross-sectional household surveys were performed in 2011 (n=1000), 2015 (n=1136) and 2021 (n=772). Data were collected from possible samples of children aged 7-9 years. From 112 primary schools in the city, which included 41 girls 'schools and 71 boys' schools, students were selected in clusters based on gender, educational level and place of residence (city and village). Data were collected using a questionnaire.

Results: Between 2011, 2016 and 2021, the prevalence of underweight was 11.6%, 12.05% and 11.78% (decrease of 5%) and the prevalence of overweight was 11.6%, 16.02% and 18.91% (increase of 80%), respectively. Of the total subjects, there was also a significant relationship between body profile status and gender compared to the standard (P=./003). Overweight was more common in girls than boys and underweight was more common in boys than girls. (20.3% vs. 17.8% in 2011, and 19.3% *vs.* 18% in 2016, and 22.9% vs. 17% in 2021 respectively).

Conclusions: During the analyzed period, there was a marked increase in overweight prevalence. At the same time, an exponential increase was observed in the overweight prevalence. Currently, underweight is a problem of low magnitude, while overweight has become a worrying public health problem. Hence, this finding indicates that we are in the transition phase to overweight and obesity in children. Therefore, the implementation of intervention programs to prevent high-risk behaviors and overweight in children seems to be essential

Keywords: Child nutrition disorders; Protein-energy malnutrition; Obesity; Nutrition surveys; School child

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Introduction

Nowadays, the relationship between malnutrition and diseases has been clearly proven. Slimming and obesity are the main problems of malnutrition, each of which has irreparable health effects [1]. Increasing the prevalence of obesity in children is one of the biggest public health problems in developed and developing countries that cause many complications in childhood and adulthood severely [2]. One of the important consequences is the negative psychological and physical effect on children and especially increasing the risk of obesity in adulthood [3]. Moreover, it causes such chronic diseases as cardiovascular disease, diabetes, hypertension, cancer and among others [4]. Besides, one of the important side effects of underweight is its

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harmful effects on learning. To be exact, nutrition transfer is a process that has occurred worldwide [5]. While this process is incomplete, problems with Double Malnutrition (DBM) are prevalent in the population. DBM is the coexistence of nutritional deficiencies (micronutrient deficiencies, underweight and childhood stunting and overweight) and both overweight and obesity that affect countries, families and individuals [6]. Overweight, obesity and nutritional deficiencies are generally risk factors for adverse health outcomes throughout life [7]. Findings from a study of about 130 million children, adolescents and adults from 200 countries around the world showed that from 1975 to 2016, the prevalence of protein-calorie malnutrition in children under 10 was systematically declining. On the other hand, the rising trend of child obesity in many high-income countries, although at high levels, is growing rapidly, but in other parts of the world continues to grow rapidly. These differences are related to the level of economic development of countries. Therefore, in the poorest regions of the world, there may be a double burden of nutritional problems [8]. The increasing prevalence of overweight and obesity in children in developed countries is due to changes in their lifestyle, which is largely related to variables related to the ancestral style of urban life, such as spending a lot of time watching TV and using diets. High fat and inactivity are its accelerating factors [9]. Some research has shown that growth monitoring in childhood, in addition to identifying nutritional problems and the level of public health, also has a positive effect on health in old age [10]. Numerous studies have been conducted worldwide to determine the prevalence of obesity and weight loss. The prevalence of obesity in a study conducted by Sun et al. In southern Brazil was reported to be 5.3% [11]. In the United States, the prevalence of overweight and obesity in children was 22% and 11%, respectively and according to studies, overweight in children in Spain and Italy 40%, Canada 3.2% and Greece 22% Turkey 10.6%, India 10%, Malaysia 16.3% and Kuwait 30% In Iran, there are few studies on the prevalence of obesity and overweight in children, some studies in Iran reveal that its prevalence has been increasing in the last decade so that in Tehrani female students in primary school the prevalence of overweight and obesity were 13.3% and 7.7%, respectively and in another study Which showed the prevalence of obesity in primary school students in Zahedan, 3.5% of obese children and 2.5% of very obese children were evaluated. Zahedan reported 18.3% and 1.3%, respectively [12]. In the study of children aged 7 to 10 years in East Tehran, weight loss was 28.9% and weight loss in severe, moderate and mild degrees were 0.7%, 4.1% and 25.4%, respectively. Also, regarding the prevalence of obesity and thinness in 1646 7-year-old children in Malayer city, based on weight, 48 were obese, 923 were normal and 675 were thin [13]. Hence, as outlined above, Childhood obesity is a public health problem that has increased in many cities and countries throughout the world. This is owing to overweight related diseases that already occur in childhood, including type 2 diabetes, high blood pressure, non-alcoholic fatty liver disease, obstructive sleep apnea and dyslipidemia in particular and especially in adulthood, given that Obese people are a big concern in any societies. A child is more likely to become an obese adult. Only a small proportion of obese children have a major endocrine or genetic cause for weight gain. Therefore, the main cause of fat accumulation above the level intended for health (which determines the condition of obesity) is a positive energy balance. This is due to excessive calorie intake and/or low pattern of physical activity which is associated with metabolic genetic predisposition to body fat accumulation (17-20) Our country, Iran, like many other countries, is going through a diet from nutrition-induced weight loss to obesity due to improper nutrition, which is one of the main axes in assessing the health and disease of society and considering that this issue can lead to a decrease in efficiency in adulthood and ultimately reduce the growth rate of economic, social and national development and in recent years there is no information on its prevalence in the southern regions of Iran, so we decided to evaluate the prevalence of obesity and thinness for the first time in children aged 7 to 9 years in Bushehr city in order to play an important role in the necessary planning to reduce disorders and improve their health by being aware of the physical health of students [14].

Materials and Methods

The subject of the study was the prevalence of obesity and thinness in children aged 7 to 9 years in Bushehr. This study is a cross-sectional and is a descriptive-analytical study. Prevalence in this study was calculated as the percentage of obesity and thinness. This prevalence in the study population, which was boys and girls aged 7 to 9 years, was calculated according to age, sex, place of residence and a number of social indicators (type of occupation of parents, etc.). Children were selected based on previous studies 20%. Based on the 95% validity level and maximum error of 3%, the required sample number of 1000 students were estimated in 2011, 1134 students in 2016 and 772 students in 2021. We selected 112 primary schools in the city during each year involved, which included 41 girls 'schools and 71 boys schools, in a cluster based on gender, educational level and place of residence consisting of city and village (70.7% urban and 29/3% rural) [15].

Multi-stage sampling was initially done by selecting a school as a cluster from among the city's schools. The number of clusters included 25 schools that were systematically selected from among primary schools. Then, in each school, 40 students were among the age groups. 7 to 9 years were selected by simple random sampling. Student dissatisfaction and having certain diseases (such as cardiovascular, pulmonary, gastrointestinal, renal and liver) that affect the child's development were among the exclusion criteria. Who met the inclusion criteria, completed the questionnaire, which included questions about age, gender, birth weight, parents 'education, parents' occupation, TV viewing hours, and bedtime, through the interview. Then, the weight was measured with a minimum of clothes and without shoes using a digital scale of saka model with an accuracy of 100 grams. The height, with accuracy 0/1 cm was calculated in the standing position while the legs are together and the knees, hips, shoulders and back are along a vertical line and the head is straight forward. Considering that the body mass index in childhood not suitable for growth status, the BMI percentile for age and sex, adjusted by the US Centers for Disease Control and Prevention (CDC) in 2000, was used for each year investigations. For statistical analysis of the data, SPSS statistical software 22 was

used to describe the data of mean and standard deviation indices and to compare the prevalence indices in population subgroups of Chi-square test and to compare the mean of anthropometric indices in population subgroups of ANOVA, T tests and economic indicators with obesity and thinness logistic regression was used.

Data collection

In all three surveys, data were obtained by well-trained and well-supervised interviewers. All methods and tools were tested in a pilot study. Information was obtained in the relevant schools through interviews with the child's mothers or teachers. Anthropometric measurements were also obtained on the same occasion. Although the equipment used in each of the three surveys was not exactly the same, they were systematically calibrated and tested according to a standard criterion, so that this aspect certainly did not interfere with the reliability of the results.

Ethical aspects

The Research Ethics Committee of the Bushehr University of Medical Sciences approved the projects for the three years surveys. All the participants in the study were informed about the study objectives, its risks and benefits, and the children's mothers or teachers signed the free and informed consent form.

Results

The aim of this study was to determine the prevalence of obesity and thinness in children aged 7 to 9 years in Bushehr in 2011, 2016 and 2021. In these studies, the average=standard deviation of age was 7 years. These children spent an average of 2 hours a day (2011), 3 hours a day (2016) and 3.5 hours (2021) watching TV and computer games, and the average amount of sleep in all three studies was 9 hours. Among the subjects studied in 2011, 29.1% in 2016, 21% and in 2021, 18% had professional sports activities. In terms of parents' education in 2011, 37.5% of the subjects studied their father's literacy level in high school, 39.9% were at the university level and 22.6% were illiterate. In 2016, this rate was 43%, 56% and 18%, respectively, also in 2021, 26%, 60% and 15% were recorded. This distribution in mothers (in 2011 including 39.1% high school and 32.9% university and 28.1% illiterate, in 2016 including 41.1% high school and 43.9% university and 21.1% illiterate and in the year 2021, including 54.1% high school, 62.9% university and 18.1% illiterate) was also different. The father's job in the 2011 survey was half of the employees and 37.7% of business and market people and only 3.7% unemployed. In 2016, in 60% of employees and 30.7% of business and market people and only 4.7% unemployed and in 2021 in 55% of employees and 35.7% of business and market people and only 6.7% unemployed Was. While most mothers (in 2011, 77.7% in 2016, 70% and in 2021, 68%) were housewives in all three studies. Birth rates of children in 2011, 2016 and 2021, respectively 50.1, 53% and 57% were primiparous and 7.2%, 5.4% and 4.5% of cases in 2011, 2016 and 2021 were the fourth child and later and in 2011, 2016 and 2022 were 97.4%, 97.7% and 98.4% of single cases (not twins), respectively. Of the total subjects studied in 2011, 2016 and 2021, 23.1%, 31.3% and 38.3% of children, respectively, had skipped breakfast. Of the total study population in 2011, 2016 and 2021, respectively (12.2%, 12.05%, and 11.78%) underweight and (65.3%, 60.73% and 53.49%) Normal and (11.6%, and 11.17% and 15.80%) were overweight and (10.9%, 16.02% and 18.91%) were also obese (Table 1). Also, there was a significant relationship between body profile status and gender compared to the standard in all three studies (P =003). In the first study (2011), obesity was more common in girls than boys and underweight was more common in boys than girls. (14.4% vs. 8.9% in 2011) (Figure 1).

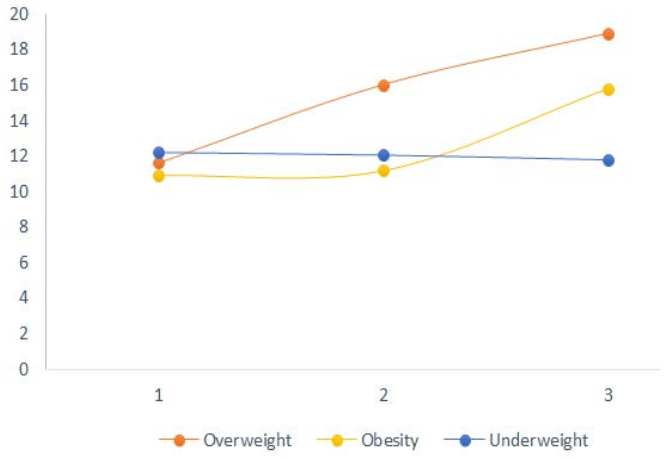

Figure 1: Time trends (2011, 2016 and 2021) of the underweight and overweight prevalence.

Table 1: Frequency distribution and percentage of BMI status in three years.

Years	Sample	Underweight	Overweight	Obesity	Normal
2011	1000	12.20%	11.60%	10.90%	65.30%
2016	1136	12.02%	16.02%	11.17%	60.735
2022	772	11.78%	18.91%	15.80%	53.49%

In relation to age, the prevalence of overweight in all three studies conducted during 2011, 2016 and 2021, this rate showed a tendency to increase after the age of 8 years. In girls, this relationship was not statistically significant, but in boys it increased significantly with age. Also, the lowest prevalence of overweight in boys was in 2011 (8.9%), 2016 (10.15%) and in 2021 (13.5%) at the age of 7 years. On the other hand, the highest prevalence of underweight was seen at the age of 7 years (in 2011, 2016 and 2021, with the respective 20.3%, 18% and 17% in boys and 17.8%, 19.39% and 22.9% in girls). The risk of obesity and overweight in students with increasing parental literacy in all three studies showed a growing trend but was not statistically significant. In all three studies, there was a significant relationship with mothers 'jobs, but not with fathers' jobs. In all three studies, underweight was higher in rural residents than in urban areas (11.9% *vs.* 8.7% in 2011, 11% *vs.* 10% in 2016 and 10.4% *vs.* 12.3% in 2021) but in general no significant relationship was observed between rural and urban with BMI status of children compared to the standard percentile which these trends in urban subjects were higher than rural participants. Besides, obesity and overweight in girls were significantly higher than boys (9.2% *vs.* 8.5% and for overweight 20.3% *vs.* 17.8% in 2011 and 10.3% *vs.* 8.7% and for overweight 19.3% *vs.* 18% in 2016 and 13%

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vs. 9.7% and for overweight 22.9% *vs.* 17% in 2021. In all three studies, unlike boys, Professional exercise did not cause weight loss in girls, but in general, there was a significant relationship between exercise and weight loss and obesity, but there was not a statistically significant relationship between the risk of obesity and overweight with the TV viewing index and children's sleep index (Table 2).

Table 2: Distribution and percentage of BMI status according to socioeconomic factors.

Factors		Underweight			Overweight		
		2011	2016	2021	2011	2016	2021
Gender	Boy	8.90%	10.15%	13.50%	17.8	18%	17%
	Girl	9.40%	8.30%	7.60%	20.30%	19.30%	22.90%
Living place	Rural	11.90%	11%	10.40%	8.50%	8.70%	12%
	Urban	8.70%	10%	12.30%	9.20%	10.30%	22%

Discussion

The prevalence of childhood obesity in the entire world remains high, with ~1 in 5 children having obesity [16]. Despite intense clinical and public health focus on obesity and weight related behaviors during the past decade, obesity prevalence remains high, with scant evidence that these efforts are counteracting the personal and environmental forces that contribute to excess weight gain in children, at least on a national scope [17]. These findings are disappointing in light of reported decreases in obesity prevalence in younger children which was the only age group as a whole to see a significant increase in prevalence since the 2011–2021. To put it simply, the upsurge in the childhood overweight prevalence in Bushehr in recent years has been higher than that observed worldwide. Reports of UNICEF/WHO/World Bank demonstrated that in 27 years (1990–2017) the worldwide overweight prevalence in children under 5 years increased from 4.8 to 5.6%, that is, the overweight prevalence in Bushehr in 2011 (11.6%) exceeded that identified in 2017 globally. The prevalence found in 2016 (16.02%) was similar to that found in South Africa (13.7%) in the last global report (2017). similar to the current prevalence in the continent (11.7%) [18]. The aim of this study was to determine the frequency of obesity and thinness in students aged 7 to 9 years during three periods of examinations in Bushehr. In the present study, 10.9% of children in 2011, and 11.17% in 2016 and 15.80% in 2021 were obese, respectively, which in the study of children who immigrated to Germany 3.1% and in children German 2.5% and in Malaysia 3.6%, in Italy 8%, in Brazil 15.2% and in Canada 21.3% was totally different. In the present study, the frequency of obesity and its range was more than this range in study conducted by Karaji Bani in Zahedan (1.4%), Assar in Ahvaz (2.2%), and Taheri in Birjand (3.3%), Soheilifard in Hamedan (5.7%) and Mozaffari in Tehran (7.7%). On the other hand, the result were the same as the study conducted by Tabatabai in Ahvaz (10.9%) and has been less than the prevalence of obesity in the correct study on Yazdi children (13.3%). Although the prevalence of overweight and obesity in this study is much lower than studies in developed countries such as Canada, Greece and the United States, but its prevalence is higher in children in India (10%) and Malaysia. These differences in different studies are probably due to the influence of factors and factors related to geographical environment and residence (urban and rural) and different age range and different social and economic conditions and gender studied in different studies and most importantly the trend. Obesity occurs over three periods in different years and over time, similar to which has rarely occurred in the country and the world. Compared to the results of studies conducted in Iran, in Shahgholian study, the prevalence of obesity in children aged 7 to 12 years in Chaharmahal Bakhtiari province was 9.9% and in Ms. Salem study in Rafsanjani primary school students, the prevalence of overweight and obesity was 11% and 9.4% respectively and in the study of Mozaffari et al. (2011) in Tehran primary school students, the prevalence of overweight and obesity were reported to be 13.3% and 7.7% respectively, which is largely consistent with the current study and the difference of the observed part is due to differences in nutritional behaviors and physical activity and other factors affecting growth in different regions. But all studies agree on the important point that the passage of nutrition in the world and consequently in Iran and even small cities far from the center of country shows its effects with obesity and overweight and has affected not only adults but also children [19]. There are few long-term studies of obesity progression or treatment outcomes because they occur in an environment with the largest losers, focusing on short-term weight changes that we have recently seen as a misguided follow-up in the adult population. These efforts are hampered by reduced research costs, limited reimbursement or lack of prevention and treatment costs, and difficulties in changing local and national policies that affect environmental health. Finally, there is evidence linking poverty to obesity, which undoubtedly affects the health of children across the country. Activities aimed at reducing the prevalence of childhood obesity should not be stopped, but a redoubled effort to improve the health of children and families and prevent the increase in health care costs in Iran.

Equal importantly, the prevalence of underweight in children in this study was 12.2% in 2011 and in 2016, 12.05% and in 2021, 11.78% but in the study of Saddle et al. (1%) and Gore et al. In Turkey reported a prevalence of weight loss in students aged 6 to 16 years (4.6%). Ms. Salem reported the prevalence of weight loss in Rafsanjan students was 13.3% and Mr. Hajian et al. Reported the prevalence of weight loss in students aged 7 to 12 years in Babol (13.5%). Aman Elahi et al. The prevalence of weight loss in primary school girls in Tehran was 13.5%, which is higher than the average and prevalence results obtained during the three study periods in the present study. In elementary school students in Bandar Abbas, 12.2% reported the same, and on the other hand, the prevalence of weight loss in this study with saddles in Malaysia and the study of graves in Turkey is much higher, perhaps due to factors affecting growth and Sampling of age subgroups in different studies or due to differences in social, economic and nutritional status. Based on the findings of this study [20].

Conclusion

It can be concluded that although the statistics of underweight and weight loss have been declining, which can be related to increasing household income and purchasing power, or increasing parents' education and raising their awareness, control programs are still needed. To control weight loss and follow the short stature

and backwardness of intellectual and educational performances in children. A study conducted by Lima et al. Is the same as the findings of the present research by indicating that the decline in stunting and underweight in northeastern Brazil was associated with changes in socioeconomic conditions of more impoverished families, which showed proper affordability in purchasing power, maternal education and awareness, basic sanitation and access to higher medical care facilities? The period analyzed in their study, in which there was a significant change in the children's nutritional status, encompassed the governments that promoted the country's re-democratization, implementing a series of public policies that undoubtedly contributed to the improvement of the population's health level in Brazil. Therefore, ensuring better socioeconomic circumstances for the population coincide with actions that promote global access to education and health care is a substantial and radical strategy in the fight against hunger and child's underweight trends. As already outlined, the prevalence of obesity and overweight evolved in the opposite way to that of underweight, showing an upward trend during the analyzed period concerned, going from an irrelevant situation to a worrying public health problem in this population.

In this study, the prevalence of obesity and overweight in girls was significantly more common than boys, while in other studies, the prevalence of obesity in boys was significantly higher than girls, which differs from the results of the present study. This difference between the sexes may be due to differences in growth pattern changes in girls and boys of the same age and differences in eating behaviors and other behaviors related to children's health status. However, some studies have shown the prevalence of obesity in girls and boys. They were close to each other or in some cases more in girls than boys. Study of TabaTabaei et al. In Ahvaz primary school students, the prevalence of overweight in girls was significantly higher than boys. This is completely consistent with the results of the present study. This difference may be due to the effective role of environmental factors or due to differences in the assessment method and criteria for diagnosing obesity and thinness. In the present study, there was no relationship between BMI status and father's job compared to the standard percentile, but there was a significant relationship with the job of the mother compared to the standard percentile. In the study of Shahgholian, et al. There was no significant relationship between economic and social status of the family and the father's occupation with the rate of child obesity. This is consistent with the findings of the present study. And colleagues in Turkey showed a significant relationship between underweight and family income. In the study of Khaja, et al. In Pakistan, the father's job was reported as a factor in growth retardation. Also, in Ms. Aman Elahi's study on primary school girls in Tehran, the relationship between obesity and father's job was significant, which was contrary to the present study. This could be due to cultural and economic differences between different regions. Based on the results of this study there was no significant relationship between parents' literacy level and children's BMI status. In the study of Shahgholyan, et al. in Shahroud, there was a significant relationship between the prevalence of malnutrition and parents' education. The number of children was also consistent as an attributed factor because "mother with three or more children" was a risk factor for malnutrition in both 2015 and 2021 survey, showing that more considerable investments in education are needed to improve the population's health standard. In contrast, a mother with up to two children was a risk factor for overweight (only in the 2011 survey). Regarding the higher underweight prevalence among children whose mothers had three or more children, it can be speculated that, under this condition, the mother would have less time to take care of her children and, additionally, there would be less availability of food at home. A Chinese study revealed that being a single child is about four times more likely to be overweight than those having siblings, leading the authors to conclude that China's one-child policy might have contributed to its rising childhood obesity rates. In this study, the inverse relationship observed between the index of physical activity in leisure and the risk of obesity and overweight in girls is consistent with the results of several studies in different countries. But in general, in this study, a significant relationship was observed between physical activity index and obesity risk. The lack of statistical correlation between the latter cases may be due to the uniformity of exercise programs in schools and the fact that since the prevalence of obesity is higher in girls, it is possible that they have just started exercising professionally in order to lose weight. In the present study, there was no significant relationship between the frequencies of obesity in children with watching television. On the other hand, in the study of Salmon et al., Watching TV with obesity has been reported because the probability of it is less physical activity and the effect of advertising for more shopping and as a result of consuming more snacks and snacks and soft drinks. In the present study, the frequency of overweight and obesity in children had no significant relationship with the amount of sleep time which is consistent with the present study. But in another study of 7-year-olds, less than 9 hours of sleep was associated with obesity and increased body fat.

The findings of this study show that although the problem of weight loss is still relatively common among 7-9 years old students in Bushehr, but the most important issue is the growing prevalence of overweight and obesity. Public health efforts to address obesity in children have been extensive, from academic campaign to the health Academy of government establishing a Section on health centers on Obesity in 2000 that is distinct from other groups in the academy as well as countless efforts led by states, hospitals, and communities. Despite these efforts, which may have had greater impact in defined populations, more resources are clearly necessary. The obesity epidemic is becoming endemic, and this decline in Iranians' health is occurring without impactful policy at the national level. Evidence based efforts focused on policy, family based change, and health improvement (versus weight loss alone) may take another decade to see positive results; effective prevention and treatment interventions remain undeveloped or have not been effectively disseminated, and more insight is needed into the moderators and mediators of excessive weight gain. Additionally, evidence that behaviors in high risk groups start at a young age suggests that efforts need to focus early on children's lives. Thus, this finding indicates that we are in the transition phase to overweight and obese in children, so the implementation of intervention programs to prevent

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high risk behaviors and overweight in children seems absolutely crucial.

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