ORIGINAL ARTICLE

The Prevalence of Childhood Obesity and Some Biological-Environmental Associated Factors in Neishabour-Iran, Winter 2006

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ABSTRACT

OBJECTIVE: The prevalence of childhood obesity is increasing worldwide. This study investigated the prevalence of obesity and its associated factors in schoolchildren of Neishabour, winter 2006.

MATERIALS AND METHODS: In a cross–sectional study, 1471 students, aged 6-12 years, were selected by a two-stage cluster sampling. Height and weight of the students were measured and BMI was calculated. A hundred and fourteen subjects were selected as a case group (had a BMI $\geq 95^{th}$ percentile of Iranian reference) and control group (n = 102) were chosen from the students having $15^{th} \leq BMI \leq 85^{th}$.

RESULTS: The prevalence of obesity was reported to be 8.5 % (CI 95%, 7.1-10%), 4.6% (CI 95%, 3.5-6%), 7.3% (CI 95%, 6-9%) according to the Iranian reference, CDC 2000 and IOTF 2000, respectively. Obese children had significantly higher birth weight than the non-obese ones. The ratio of the first and second born child in the case group was significantly higher than in the control group ($P < 0.001$). Also, the rate for children who began taking their complementary foods under 6 months of age was significantly higher in the case group (80.7%) than control group (46.1%). There was significant difference in the mean time of watching TV and playing computer games between the case and control groups ($P < 0.001$). Significant association was found between BMI and the above-mentioned variables in the case group. Mean scores of physical activity differed in the case and control group ($P < 0.001$).

CONCLUSION: Since the prevalence of obesity differs based on various references, it is recommended that each country applies the most relevant BMI percentile for assessing its children. Obesity had significant association with high birth weight, birth grade and the age of the introduction of complementary food. The findings of this study may be helpful in implementing practical interventions to prevent obesity and overweight in the study population.

KEYWORDS: Body Mass Index, Obesity, Children, Youngsters, Environmental Factors, Biological Factors, Sleep Duration.

INTRODUCTION

The prevalence of obesity and overweight in children and youngsters is rapidly increasing in the developed and developing countries (1-4). In Canada, the prevalence of obesity in 7-13 year-old children showed an increase from

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5% in 1981 to 15% in 1996 (5). During the last decade, the prevalence of obesity has been also increasing among children and youngsters in Brazil and China (6,7). It is predicted that by 2020 more than 60% of diseases and their related mortality and morbidity in the developing countries will be due to non-contagious diseases, for many of which obesity is a potential risk factor (8). Studies report the prevalence of childhood obesity in Iran to be 6-17%, (9,10). This alarming rise indicates that the overweight and obesity among children and youngsters in Iran is a major public health problem (11). Obesity during the growth ages is associated with many short and long term complications; however the burden of obesity on health is especially due to its long term complications (12,13). Childhood obesity increases the incidence of cardiovascular diseases, cancer and diabetes in adulthood (2,12). Several studies in different parts of the world have reported different results in the prevalence of obesity among children. The prevalence of obesity among children in France in 2000, was reported to be 14.9%, 6.4% and 3.8%, based on the French reference (BM1 ≥ 97 percentile), CDC 2000 and IOTF 2000, respectively (14). Dorosty et al. conducted a study on 4315 children aged 2-5 years, showed that over 7% of children had BMI over 95 percentile based on the Iranian reference (Hosseini et al., 1999) (10).

Obesity is a multifactorial consequence. Besides genetic, metabolic, socioeconomic and cultural factors, life styles such as unsuitable dietary habits, low physical activity levels, season of birth, weight and grade and other factors like breast feeding and the age at introduction of complementary food are among factors affecting obesity (15).

Due to the climatic and cultural differences in various regions of Iran and the lack of relevant data from Neishabour, this study was conducted to determine the prevalence of childhood obesity and some biological-environmental associated factors in children of Neishabour.

MATERIALS AND METHODS

Sample collection: In a cross-sectional study in Neishabour, 1471, children aged 6-12 years, from 60 schools were evaluated in winter 2005. The sample size was originally 1500 children (CI: 95%), of which only 1471 children were evaluated due to a lack of cooperation by either the schools or children. Sampling was performed using two-stage cluster sampling method (16). On the first stage, 60 clusters were selected using a systematic random sampling method (16). Initially primary schools, both public and private, and the students of each class were identified. Then, cumulative frequency of the studied population was calculated. The cluster count was calculated by dividing the number of school children into 60 (the number of clusters). The first class and school were determined by randomly selecting one digit between one to the number of cluster count. The clusters were identified by adding this randomly selected digit to the cluster count. On the second stage, in each cluster, 25 school children were randomly selected from the class attendance register. Those students who had a BMI ≥ 95^{th} percentile of Iranian reference, were selected as the cases (114 persons). The first non-obese student exactly after each case was selected as the control. Finally 102 students were selected as the controls.

Measurements: The age and sex of each student was documented in a questionnaire; height was measured by a Seca height meter, in a standing position with bare feet (precision 0.5 cm) and weight was obtained with a digital scale (sensitivity 0.1 kg), while wearing clothes but no shoes. BMI was calculated by dividing the weight (kg) by height square (m^2). The prevalence of obesity was determined based on the Iranian reference (1999), CDC 2000 and IOTF 2000, respectively (17-19). The obese children were identified based on BM1 ≥ 95 percentile, regarding the Iranian or CDC 2000 reference values, BMI equal or more than IOTF reference values. The information related to obesity was obtained by questioning the mothers. Physical activity was

evaluated using the Beacke et al. questionnaire (20).

Statistical Analysis: Data were analyzed using the EPI-Info and SPSS software. Student's T-test was used to compare the differences between the means of variables and chi-square test was used to compare the frequency of variables. Pearson correlation was used to investigate correlation between two variables. In all tests, the level of significance was $P < 0.05$.

RESULTS

Of the 1471 schoolchildren selected, 822 (60%) were boys and 649 (40%) girls. The highest prevalence of obesity reported was 8.5% based on the Iranian reference ($P < 0.001$), whereas the lowest was 4.6%, based on CDC 2000 reference values. A significant difference was found between the results obtained using the Iranian and CDC 2000 reference. However, no difference was found between values obtained using the Iranian and IOTF references (Table 1).

A significant difference was found in the prevalence of obesity between two sexes in the 7-8 year-old age group ($P < 0.05$), whereas none of the students in 6 and 12 year-old age group were obese, based on the Iranian reference. Based on CDC 2000 reference, there was a significant difference between boys and girls in 8 year-old age group ($P < 0.05$). The prevalence of obesity in schoolchildren was reported to be 7.3%, while none of the 12 year-old age group was obese according to IOTF criteria. Also no significant difference was observed in the prevalence of obesity between two sexes based on IOTF reference (Table 2)

Table 1- The prevalence of obesity in 1471 children studied, using different references, regarding age

IOTF 2000		*CDC 2000		Iranian (Hosseini et al.)		Reference	
%	n	%	n	%	n	Age	n
5.1	9	7.9	14	0	0	6	177
5.5	13	6.3	15	(11.8)	28	7	238
5.6	12	5.3	12	8.8	20	8	228
8.5	22	4.2	11	26	10	9	259
8.6	32	2.7	10	9.6	36	10	374
11.5	20	3.4	6	9.2	16	11	174
0	0	0	0	0	0	12	21
7.3	108	4.6	68	8.6	126	Total	1471

Table 2- Comparison of the prevalence of obesity in the studied children, regarding sex and age

Reference	IOTF 2000		CDC 2000		Iranian (Hosseini et al.)	
Sex / Age	Girl	Boy	Girl	Boy	Girl	Boy
6	3(2.75)*	6(8.82)	5(4.60)	9(13.20)	0(0)	0(0)
7	3(3.22)	10(6.89)	5(5.40)	10(6.90)	6(6.45)	22(15.7)
8	2(2.00)	10(7.80)	2(2.0)	10(7.8)	4(4.00)	16(12.5)
9	11(10.00)	11(7.38)	3(2.72)	8(5.4)	12(10.90)	14(9.39)
10	16(11.51)	16(6.80)	2(1.43)	8(3.40)	17(12.23)	19(8.00)
11	14(15.90)	6(6.97)	3(3.40)	3(3.50)	10(11.40)	6(6.97)
12	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Significant difference was seen in birth weight between the case and control groups ($P < 0.001$). In 41.2% of obese children, birth weight was higher than 4000 gr, whereas only 14.7% of non-obese children weighed more than 4000 gr at birth. The risk of obesity in children with birth weight over 4000 gr was 3.94 times more than those with less birth weight ($1.90 < OR < 8.23$). Mean birth weight in obese children (3900.9 ± 846.2 gr) was significantly higher than non-obese ones (2837.1 ± 671.3 gr).

No difference was found in season of birth between the obese and non-obese children ($P > 0.05$). Percentages of children born in spring, summer, autumn and winter were 32.5%, 28.9%, 16.7% and 21.9% in case group and 24.5%, 33.3%, 17.6% and 24.5% in control group, respectively.

The rate of first and second birth grade children in case group was significantly higher than control group ($P < 0.001$). The risk of obesity in the first born was 2.11 times higher than the other schoolchildren ($1.10 < OR < 4.07$).

There was no significant difference in duration of breast feeding between the case and control group (obese children: 22.02 ± 9.86 months, non-obese children 23.7 ± 14.3 months) ($P > 0.05$). Both case (88.6%) and control groups (91.2%) were on breast feeding for a duration of ≥12 months. Also no significant association was found between BMI and the duration of breast feeding in obese children. A significant difference was observed in the age-onset of complementary food between the case and control groups ($P < 0.001$). As Figure 2 shows, the ratio of obese schoolchildren who began complementary foods earlier than 6 months of age (80.7%) was significantly higher than control group (46.1%).

Table 3 and Figure 1 show that mean time of watching TV and playing computer games and other electronic devices are significantly different between the case and control groups ($P < 0.001$).

Table 3- Mean and standard deviation of the continuous variables in the studied population

Variables	Groups		
	Case (n = 114) Mean ± SD	Control (n = 102) Mean ± SD	P-Value
TV watching time (hours/day)	4.3±1.5	2.4 ± 1.0	<0.001
Playing computer game or electronic devices (hours/day)	1.1±1.1	0.38±1.1	<0.001
Physical activity score	2.3±0.4	3.0±0.4	<0.001
Sleep duration (hours)	10.4±0.9	9.7±0.8	<0.001

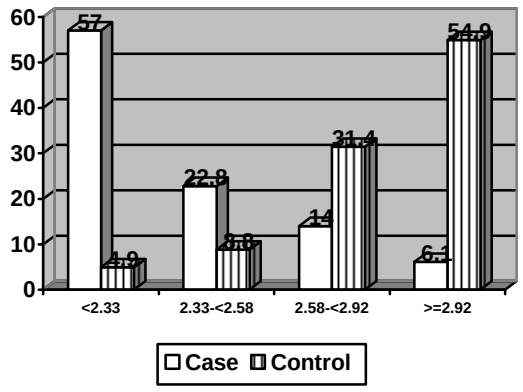

Figure 1- Physical activity score in the case and control groups

* ($P < 0.001$): Significant difference between case and control group

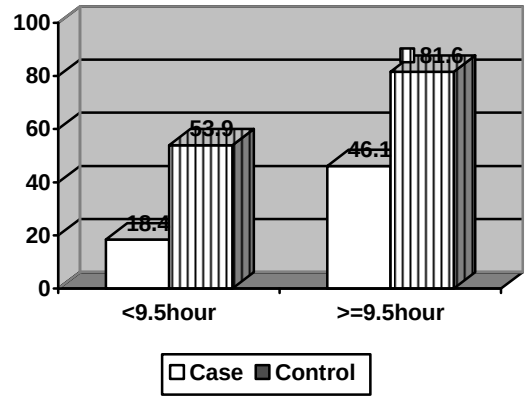

Figure 2- Sleep duration in the case and control group

* ($P < 0.001$): Significant difference between case and control group

Table 4- Pearson coefficient between BMI and independent quantitative variables in the studied population

Variable	Pearson coefficient	*P* Value
TV watching time (hours)	-0.259	0.005
Sleep duration (hours)	-0.135	NS
Physical activity score	0.165	NS

Also significant and positive association was found between the BMI and the above-mentioned variables in the case group (Table 4, $P < 0.001$). No significant association was found between the BMI and the mean score of physical activity in the obese schoolchildren (Table 4).

Table 3 shows that mean score of physical activity level is different between the case and control groups ($P < 0.001$).

Table 3 and Figure 2 show a significant difference in the mean time of sleep duration between the case and control groups ($P < 0.001$). No significant association was found between BMI and mean time of sleep duration in obese children (Table 4).

DISCUSSION

The prevalence of obesity in the study population was 8.5%, 4.6%, and 7.3%, based on the Iranian, CDC 2000 and IOTF 2000, respectively. Tabatabaie et al. in a study of schoolchildren in Ahwaz reported an obesity prevalence of 10.9%, 5.2% and 3.6%, according to the Iranian, CDC 2000 and IOTF references, and the findings were similar to those of the present survey (21).

The prevalence of childhood and adolescent obesity was reported to be 11.7 and 11.3% in England and China, respectively (6,7,12). As it is noticed the prevalence of obesity in schoolchildren in Neishabour is very similar to that of other regions of Iran and other countries. In the present study, a significant difference was found in the prevalence of obesity using different references, in agreement with the results of the study by Tabatabaie in Ahwaz (21). In a study by Hojjat in Tehran in 2001, a significant difference was found in the prevalence of obesity in 8-10 year-old girls, based on 3 different references; 16%, 9.6% and 6% based on the Iranian, CDC and IOTF references, respectively (22). It was similar to the findings reported by Dorosty et al. in a study of 3-5 year-old children, which revealed significant difference in measurements, based on these three references in Gilan and Sistan-Balouchestan (10).

In the present study, there was no significant difference in the prevalence of obesity between two sexes, while a significant difference was observed in 7-8 year-old children based on the Iranian reference and in 8 year-old children based on CDC 2000 reference regarding the sex.

In the study by Karam Soltani, no difference was found in childhood obesity between the two sexes, while different age groups reported to have different prevalences of obesity based on the Iranian reference. This is contrary to results based on other references that found no difference in the rate of obesity among various age groups (23).

In the study by Tabatabaie, no significant difference was found in the prevalence of obesity between two sexes; the prevalence of obesity was significantly associated with age. Nine year-old schoolchildren had a higher prevalence of obesity in comparison with 8 year-old children (14.8% vs. 8.8%), whereas 10 y-old children had lower rate of obesity than 11 y-old children (10.7% vs. 16.1%) (21).

In a study on 7-9 year-old French children in 2000, no significant difference was found in the prevalence of obesity regarding age, while the CDC reference showed a lower rate of obesity in 9 year-old compared to the 7 year-old age group (14).

According to the results of the current study, birth weight of obese schoolchildren was significantly higher than other students. Studies of children in England, China and Africa demonstrated the prevalence of obesity to be associated with high birth weight values (24-26).

Mean birth weight values of obese schoolchildren in Ahwaz and Yazd were

significantly higher than those of non-obese schoolchildren with the same age and sex (21, 23). However, no significant difference was found in the mean birth weight values between obese and non-obese female schoolchildren in a region of Tehran (22)

The association found between high birth weight and a higher risk of obesity in childhood and adolescents is attributed to the metabolic, endocrine and autonomic pathways during the fetal period. Also, some studies have shown that those with high birth weight values have lower resting energy (27).

In the current study, no difference was found in the birth season between the case and control groups. In a study of African-American female adolescents, a higher rate of obesity was found in those who were born in the warmer season (28). However, no significant association was found between obesity and the season of birth in children in England (24).

In a study of female schoolchildren in a region of Tehran, a significant association was found between obesity and season of birth, showing that most of the obese children were born in autumn and winter (22).

In Ahwaz, no significant difference was found between obesity and season of birth in schoolchildren (21). The association of obesity with birth in the warmer seasons may be attributed to the effect of the cold weather on dietary intake of mother during the pregnancy period. These effects cause changes in the fetal hypothalamus growth, which regulates the function of appetite and growth centers; melatonin level can also affect this association, and decrease in level due to the shortening of the daylight hours can alter metabolism and increase body weight. These alterations in melatonin level which is regulated by the duration of the mother's light exposure, which can affect the growth after birth (28).

There was a significant difference in the order of birth between the case and control groups in this study, in a way that the ratio of the first born was found to be higher in the obese children than the non-obese ones. A first born was also associated with obesity in children in Italy and Tunisia (1,29).

No significant association was found between obesity and rank of birth order in studies of schoolchildren in Tehran, Ahwaz and Yazd (21-23). Parents tend to pay more attention to the nutrition and health care of their first born, as compared to their other children, and this could lead to childhood obesity in these children.

There was no significant difference between the case and control groups regarding duration of breast feeding. Data reveal controversial findings with regard to this; a study of children from the Czech Republic showed the prevalence of overweight and obesity was lower in the breast fed adolescents than those who were not on breast feeding (30). No significant association was found between the obesity and the duration of breast feeding in American and English children studied from birth (24,31). In a study of primary school children in Ahwaz and Yazd, no significant association was found between obesity and duration of breast feeding (21,23).

The protective effect of breast milk against obesity is attributed to its special components. Breast milk has high energy and low protein level in comparison with dry milk, preventing excessive protein intake in neonates. Long chain poly unsaturated fatty acid in breast milk may reduce the risk of obesity in the adulthood. High concentration of these fatty acids in the brain inhibits the production of cytokines and increases insulin receptors in several tissues which improves insulin and other neurotransmitter functions. As dietary intake in the body is regulated by complex interactions of some neurotransmitters, insulin and its receptors in the brain indicate the necessity of taking these fatty acids in the first year of life (32).

The age of beginning complementary foods in obese schoolchildren of Neishabour was significantly earlier than in non-obese ones. Results on the initiation of complementary foods differ; the prevalence of obesity in children, who took their complementary food earlier than 12 weeks of age, was significantly

higher than those who started later in England (24), whereas no difference was seen between obese and non-obese children of Puerto Rico (2). A significant and negative association was found between the BMI and the age at the introduction of complementary food in the obese children in Ahwaz (21).

Earlier introduction of complementary food may reduce the intake of breast milk, which may result in the higher risk of obesity.

The National Caspian study in 2003-2004 showed that 77% of the primary schoolchildren had low physical activity levels; their mean time of watching TV and playing computer games was about 8.9 hours a day (33).

In the study on schoolchildren in Yazd, no significant difference was found in the mean time of watching TV, playing computer games and other electronic devices between the case and control groups. Also no significant association was found between BMI and the duration of watching TV and playing computer games and other electronic devices in the case group (23). Hojjat in his study of 7 to 8 year-old girls in Tehran, found the risk of obesity 1.9 times higher in girls who spent most of their leisure time watching TV as compared to those who spent less time doing so (22).

Findings of a study by Tabatabaie from Ahwaz demonstrated that although no significant difference was found in the mean time of watching TV and playing computer games between these children, significant and positive association was found between the above-mentioned variables and BMI in the case group (21).

In a study conducted by Dorosty in England, the risk of obesity in children who watched TV more than 2 hours a day was 1.74 times higher than those who watched TV less than 1 hour a day (24).

In a study by Danielzik et al. in Germany, no significant difference was found in TV watching time between obese and normal children (2). Dietz believes that one of the best ways to decrease the prevalence of obesity is to limit the time of watching TV and playing computer games and to motivate such children to participate in outdoor high level, physical activities (34); watching TV and playing computer games are associated with low physical activity levels leading eventually to obesity in childhood. Such activities can affect dietary habits in children; they induce more tendency for consuming high fat and sugar containing refreshments which may lead to overweight and obesity (2,3,34).

In a study by Karam Soltani significant difference was found in the mean scores of physical activity between the case and control group (23), which was similar to the findings from Ahwaz reporting a significant difference in the mean scores of physical activity between the case and control groups. The risk of obesity in those who were in the first quarter of activity score was 2.28 times more than those who were in the fourth quarter (21). Also in the study of 8-10 year-old girls in Tehran, Hojjat found significant difference in the mean scores of activity levels between the case and control groups (22).

In 2002, Sekin et al. showed a significant association between obesity and low physical activity in children (35). A study on children and adolescents in Canada showed that obese children had lower scores of physical activity and spent less time on medium level activities in comparison with controls of the same age (36). In a study by Danielzik et al. on German children, significant association was found between the level of activity and obesity (2).

In 7-9 year-old children of Peurto Rico, an association was found between obesity and the time spent on electronic games, after adjusting the effect of other variables (37).

The results of NHANES III study, conducted on 6-18 year-old children in America, showed a positive association in girls between the time spent watching TV and obesity, after adjusting the effect of other variables like: age, race, family income, physical activity and energy intake, whereas no such association was observed in boys (38).

Low activity levels reduces energy metabolism and lipid oxidation in body tissues, causing individuals with low activity levels to be more

obese than those with higher physical activity levels (39).

In the current study, individuals of the case group went to bed later than the controls and in order to compensate for the lack of sleep, slept more during the day instead of being more physically active or exercising.

Researchers believe that there is association between the secretion of growth hormone and sleeping early at night. Going to sleep early at night increases the secretion of the growth hormone, which activates lipolysis in fat tissues, and obviously sleeping late increases the rate of obesity (40).

In the study conducted by Karam Soltani, no significant association was found between BMI and sleep duration in obese children, with no difference in the mean time of sleep between the two groups (23).

Hojjat showed that there was no association between obesity and sleep duration and no difference in the mean sleeping time of his case and control groups (23).

In Tabatabaie's study, the risk of obesity in those who slept less than 8.5 hours a day was 1.6 times higher than those who slept more.

In Germany the prevalence of obesity in 5-6 year-old children, who slept less than 10 hours, between 10.5-11 hours and over 11 hours, was 5.4%, 2.8% and 2.1%, respectively (38). In a study on American adolescents, there was an 80% increase in the risk of obesity for every one hour decrease in sleeping time (39).

In conclusion, it is note worthy that BMI values differ based on different references and applying each reference yields different values. As the definition of obesity in different countries differs due to the differences in various life styles, culture and socio economic conditions, it is recommended that each country applies the most relevant BMI percentile for evaluating its children. Also based on the findings of this study, high birth weight, birth order, and early initiation of complementary foods were associated with levels of obesity among the children of Neishabour, as were low physical activity levels. Considering the mentioned risk factors, the related authorities need to design and implement the appropriate lifestyle interventions to prevent the escalating prevalence of obesity in this vulnerable population.

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