Original Article

The nexus between body mass index and lifestyle areas among 8-12-years-old children in elementary schools of Rasht City

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ABSTRACT

Introduction: Weight and height measurement and body mass index (BMI) calculation and comparing them with standard curves are the most important international indicators used for evaluating physical growth and health. Accordingly, this study aims to examine the nexus between BMI and lifestyle areas among 8-12-years-old children in elementary schools of Rasht City, Iran.

This is a cross-sectional study with correlational type in which, 975 students of 8-12 age range participated. The sampling process was done through the cluster-random method. BMI was measured the assigned to four groups skinny, normal, overweight, and obese. The data were imported into the SPSS21 software. The results show that drinking juice prepared at home (P=0.01) is one of the factors predicting overweight. Moreover, it was concluded that doing exercise after school is one of the factors related to overweight (P=0.05), so doing exercise after school would reduce the overweight possibility by 1.4 times. No significant relationship exists between electronic entertainment and BMI. Also, daily TV watching is one of the factors leading to obesity (P=0.05), so daily TV watching would increase the possibility of getting obese by 1.2 times rather than normal individuals. A reverse relationship exists between optimal sleep and obesity (P=0.04), while loss of appetite is one of the factors related to thinness (P=0.001) (direct relationship), overweight (P=0.002) (indirect relationship), and obesity (P=0.0001) (indirect relationship). The results of the study can be used by health managers and planners to design screening programs associated with obesity and its implications among children, and to find what lifestyle areas of children must be modified and changed.

Keywords: BMI, Lifestyle Areas, 8-12-years-old Children, Schools in Rasht

Introduction

Children are undoubtedly the largest human capital, so it is necessary to implement precise healthcare policies to provide for their physical and mental health. Growth is a good and valuable index used to determine a child's health [1]; in this case, weight is one of the significant indicators of physical growth, while serving as the simplest but best growth index [2]. Weight, height, and BMI measurement and comparing them with standard curves is one of the most important international indicators used to evaluate physical growth and health [3]. BMI classification for children's age range is as follows: BMI<5th percentile indicates underweight, 5<BMI<85 indicates normal weight, 85<BMI<95 indicates risk of overweight, and 95<BMI indicates obesity [4]. It has become more and more important to use weight and height indicators to detect the health and nutrition status of children in society.

Now, childhood overweight and obesity are the most critical challenges in public health [5]. Obesity is the most substantial nutritional problem in developed countries, which has increased globally in recent decades. Nowadays, overweight has become an epidemic among children and has doubled in the age range of 6-12 [6]. The studies conducted in developing countries and the Middle East indicate the rising statistics of obesity and its ascending trend in childhood [7]. According to the statistics reported by the World Health Organization (WHO), 30% of the population living in the Middle East is overweight. The prevalence of obesity equals 5-10% in Iran's schools. Some Iranian studies indicate that obesity prevalence has been

increasing in two recent decades [8], so in a study, overweight and obesity prevalence rates among female elementary school girls in Tehran equaled 13.3% and 7.7%, respectively [9].

Obesity and overweight prevalence rates among elementary students in Zahedan equaled 10.3% and 8.9%, respectively, while these rates equaled 7.8% and 10.9% among children in Neyshabur, 14.3% and 18.8% among students of 7-12 age range in Semnan. Moreover, 11% of children of the 6-11 age range in Hamedan are overweight, and 7.95 are at risk of being overweight [10]. According to a study conducted in 2010, overweight prevalence rate among female and male elementary school students equaled 15% and 11.5%, respectively, while obesity prevalence equaled 5% among elementary school boys and 5.9% among girls [11].

Obesity increases the probability of some chronic diseases, such as cardiovascular diseases, hypertension, diabetes type 2, gallbladder diseases, osteoarthritis, some types of cancer, high blood fat, gout, aggravation of rheumatism, aggravation of respiratory failure, and diaphragmatic hernia [8]. Obese children would experience one or two risks of cardiovascular diseases, including higher blood fat, hypertension, or hyperinsulinemia [12]. Heart attack, stroke, malignancies, gallstones, and infertility among women are dome of diseases in which, obesity plays a direct role [13]. Obesity may cause adverse effects on individuals' capability to experience an active and dynamic life. According to available information, the problems caused by obesity are highly complicated since they not only result in physical problems or worsen them but also obesity and its associated medical problems may affect the individuals' ability to have an active and useful life. In the recent decade, inabilities caused by obesity have increased, and obesity has become a risk factor for disability in the lives of people [14]. World Health Organization defines obesity as a disease with a higher risk of mortality. A positive correlation exists between obesity and depression, anxiety, bipolar disorder, substance abuse and suicidal tendencies, and schizophrenia [14].

The obese children suffer from mental problems, they have a bad image of their bodies and subsequently a lower self-confidence compared to the children with normal weight [15]. Obesity in children results in some problems, such as being antisocial, low self-confidence and frustration, and obstructive sleep apnea [16]. Obese children have fewer friends than their peers and spend shorter time with their friends [17].

In addition to obesity, children's malnutrition is another problem considered by WHO. Malnutrition is defined as "developmental retardation syndrome" in developing and less-developed countries. In Iran, children with malnutrition, particularly underweight and nutritional short height are assigned to vulnerable groups, and many studies have been conducted on this topic [18]. Now, one-third (at least) of children in developing countries suffer from growth disorders, and 50 million children are skinny [19]. At present time, 79% of children with malnutrition live in Asia, 17% in Africa, and 3% in Latin America; among 12 million children below 5 who annually die in developing countries, more than 6 million suffer from malnutrition directly or indirectly [20]. According to documents reported by WHO, malnutrition is related to half of death cases among children worldwide, and children who survive malnutrition suffer from mental and intellectual disabilities. A relatively high prevalence rate of various malnutrition types exists in Iran, including underweight equals 11.9% and 9.7% among boys and girls, respectively based on the weight index for height, and nutrition-related short height equals 16.8% and 13.9% among boys and girls, respectively [21].

Obesity and underweight are multifactorial phenomena caused by interaction between several complicated factors, such as genetics and environment. Some factors like nutrition, physical activity, and sedentary life, sleep, and stress are some environmental factors affecting normal life, which are set together in the concept of lifecycle based on the definition proposed by WHO [22]. Health professionals have described lifestyle as a significant factor that affects health [23].

The increase in obesity has reached the warning line in recent years, so 22 million children are dealing with this phenomenon worldwide. It is estimated that around 80% of obese children will be obese in their adulthood too [17]. Obesity is more seen in children who have higher socioeconomic status in developed countries [18]. The prevalence rate of obesity among children and adolescents equaled 16.9% between 2009 and 2010 in the USA. Obesity prevalence has tripled (reaching from 5% to 15%) among Canadian children of the 7-12 age range between 2002 and 2005. Moreover, a study conducted in Italy obtained prevalence rates of 11.1% and 22.9% for obesity and overweight, respectively among elementary school children [24]. Children at school age acquire cognitive skills finding an opportunity to select and pursue healthy behaviors [25]. Since students create the future and socioeconomic development of the country, constant care and follow-up must be taken for them to protect and improve their health [66]. Regarding the implications caused by obesity and malnutrition and their effects on the growth and development trend of children in the coming years of their lives and the large economic impacts of these disorders on the medical systems, as well as the obese and overweighted children seen in medical centers and society, the author decided to conduct a study titled "the nexus between body mass index and lifestyle areas among 8-12-years-old children in elementary schools of Rasht City."

Materials and Methods

This is a cross-sectional study with a correlational type. The research society comprises all male and female students of the 8-12 age range who study in elementary governmental and non-governmental schools in Rasht. Research samples of this study comprised 975 male and female 8-12-years-old students in second, third, fourth, fifth, and sixth elementary grades studying in governmental and non-governmental elementary schools located in Districts 1 and 2 of Education and Training Organization of Rasht during academic years of 2014-2015. The cluster-random sampling method is used in this paper. First,

society population was measured based on the education districts (1 & 2), academic grade (2nd, 3rd, 4th, 5th, and 6th) then the population of each group was calculated based on the society fraction.

Child's BMI

Weight measurement was done using the Beurer MS50 Manual Weighing Scale, while the subject wore few clothes considering an approximate error of 100g (this scale was compared with several digital and mechanical scales, and its validity was confirmed). The height was measured using a standard tape measure, while the child had no shoes, clinging to the wall, and looking straight ahead. The height measurement was done with an approximate error of 0.1cm. In the next step, BMI was classified based on the following criteria: BMI<5th percentile: underweight, 5<BMI<85: normal weight, 85<BMI<95: overweight and 95<BMI: obesity.

The data were collected for analysis then coded and imported to the SPSS21 software.

Findings

The results showed that the majority of studied subjects (58.2%) were female, 11 years old (28.2%), in 5th grade of elementary school (27.6%) in governmental school (72.3%). The majority of subjects (69.5%) were first children of family and living with their parents (93.6%). The education level of the majority of studied subjects' parents (41.3%) was diploma, and most of them (53.8%) were self-employed. Moreover, the majority of mothers (48%) had diploma degrees and were housewives (72.7%). The majority of the studied subjects (68.4%) lived in their houses, and most of the families (42.75) had an income level of 600.000-1.000.000 Rls. Most of the parents of studied subjects (98%) read the food stuff's labels, and 68.7% of mothers and 68.9% of fathers had a BMI>24.9%.

Table 1. Estimation of regression coefficients of factors related to BMI based on nutritional habits using Multinominal logistic regression model

BMI status	Estimation Nutritional habits	Regression coefficient (B)	Standard error (SE)	Sig.	Relative chance	Confidence interval 95%	
						Lower limit	Upper limit
Skinny	Did you drink a juice prepared at home yesterday?	0.264	0.689	0.701	1.303	0.338	5.026
	Do you eat breakfast every day?	0.471	0.253	0.63	1.601	0.975	2.63
	Which one is better for health: Whole wheat bread - white bread	0.181	0.298	0.544	1.198	0.688	2.147
	Which one is better for health: egg-burger	-0.464	0.35	0.184	0.629	0.317	1.247
	Which one is better for health: vegetable salad-fries	1.017	0.465	0.02	2.764	1.111	6.874
Overweight	Did you drink a juice prepared at home yesterday?	0.977	0.383	0.01	2.656	1.253	5.632
	Do you eat breakfast every day?	0.042	0.17	0.806	1.043	0.747	1.456
	Which one is better for health: Whole wheat bread - white bread	-0.363	0.201	0.57	0.695	0.469	1.031
	Which one is better for health: egg-burger	-0.422	0.22	0.27	0.656	0.426	1.009
	Which one is better for health: vegetable salad-fries	0.53	0.311	0.088	1.698	0.924	3.123
Obese	Did you drink a juice prepared at home yesterday?	1.019	0.399	0.01	1.772	1.268	6.059
	Do you eat breakfast every day?	-0.482	0.166	0.004	1.619	1.17	2.24
	Which one is better for health: Whole wheat bread - white bread	-0.376	0.206	0.098	0.687	0.459	1.029
	Which one is better for health: egg-burger	-0.74	0.236	0.93	0.477	0.3	0.757
	Which one is better for health: vegetable salad-fries	0.155	0.342	0.651	1.167	0.597	2.282

Table 1 indicates that eating vegetable salad is one of the factors related to thinness (P=0.02), so eating this salad increased the chance of thinness by 2.7 times greater than individuals with normal weight (CI:95% OR:2.7, 1.111-6.874). According to this table, eating juice prepared at home (P=0.01) is a factor predicting overweight, so drinking this juice would increase the possibility of overweight by 2.65 times greater than those individuals with normal weight (CI:95% OR:2.65, 1.253-5.632). The table above shows that factors predicting obesity include the juice prepared at home (P=0.01) and eating breakfast (P=0.002), so drinking the juice prepared at home would increase the possibility of obesity by 2.7 times greater than the individual with normal weight (CI:95% OR:2.7, 1.268-6.059) while eating breakfast could reduce the obesity by 1.6 times greater than individuals with normal weight (CI:95% OR:1.6, 1.17-2.24).

Table 2. Estimation of regression coefficients of factors related to BMI based on physical activity using Multinominal logistic regression model

BMI status	Exercise area	Estimation	Regression coefficient (B)	Standard error (SE)	Sig.	Relative chance	Confidence interval 95%	
							Lower limit	Upper limit
Skinny	Exercise after school	Yes	-0.295	0.28	0.282	0.745	0.43	1.289
		Reference group				1		
	Regular exercise during education	Yes	-0.452	0.28	0.106	0.636	0.368	1.101
		Reference group				1		
	Regular exercise during summer holidays	Yes	-0.29	0.303	0.338	0.748	0.413	1.354
		Reference group				1		
Overweight	Exercise after school	Yes	-0.356	0.187	0.05	1.428	0.991	2.059
		Reference group				1		
	Regular exercise during education	Yes	-0.285	0.182	0.117	0.752	0.527	1.074
		Reference group				1		
	Regular exercise during education	Yes	-0.112	0.204	0.583	0.894	0.599	1.334
		Reference group				1		
Obese	Exercise after school	Yes	0.088	0.187	0.639	1.092	0.757	1.575
		Reference group				1		
	Regular exercise during education	Yes	-0.36	0.185	0.05	0.698	0.485	1.004
		Reference group				1		
	Regular exercise during education	Yes	-0.392	0.201	0.05	0.676	0.456	1.003
		Reference group				1		

Table 2 indicates that doing exercise after school is one of the factors related to overweight (P=0.05), so doing exercise after school would reduce the overweight possibility by 1.4 times (CI:95% OR:1.4, 0.991-2.059). Moreover, this table shows that regular exercise during education is a factor related to obesity (P=0.05), so regular exercise during education would reduce the obesity probability by 0.69 times rather than individuals with normal weight (CI:95% OR:0.69, 0.485-1.004). Also, regular exercise during summer holidays is another factor related to obesity (P=0.05), so regular exercise during summer holidays would decrease the obesity possibility by 0.67 times greater than individuals with normal weight (CI:95% OR:0.67, 0.456-1.003).

Table 3. Estimation of regression coefficients of factors related to BMI based on electronic entertainment using Multinominal logistic regression model

BMI status	Exercise area	Estimation	Regression coefficient (B)	Standard error (SE)	Sig.	Relative chance	Confidence interval 95%	
							Lower limit	Upper limit
Skinny	Daily TV watching	Yes	-0.135	0.143	0.348	0.874	0.66	1.158
		No						
	Playing electronic games daily	Yes	0.161	0.162	0.319	1.175	0.855	1.614
		No						
	Playing electronic games on weekends	Yes	0.009	0.15	0.953	1.009	0.751	1.354
		No						
Overweight	Daily TV watching	Yes	0.161	0.091	0.077	1.175	0.983	1.404
		No						
	Playing electronic games daily	Yes	0.007	0.102	0.944	1.007	0.825	1.23
		No						
	Playing electronic games on weekends	Yes	-0.006	0.094	0.95	0.944	0.827	1.196
		No						
Obese	Daily TV watching	Yes	0.183	0.094	0.051	1.201	0.999	1.443
		No						
	Playing electronic games daily	Yes	0.242	0.106	0.022	0.785	0.638	0.966
		No						

	Playing electronic games on weekends	Yes No	0.241	0.094	0.01	1.272	1.059	1.529

Table 3 indicates that watching TV daily (P=0.05), playing electronic games daily (P=0.02), and playing electronic games on weekends (P=0.01) are factors related to obesity, so watching TV daily would increase the possibility of obesity by 1.2 times greater than individuals with normal weight (CI:95% OR:1.2, 0.9-1.4). Moreover, playing electronic games increases the possibility of obesity by 0.7 times greater than individuals with normal weight (CI:95% OR:0.7, 0.6-0.9), while playing electronic games on weekends increases the possibility of obesity by 1.2 times greater than individuals with normal weight (CI:95% OR:1.2, 1.05-1.5).

Table 4. Estimation of regression coefficients of factors related to BMI based on the sleep status using Multinominal logistic regression model

BMI status	Sleep status	Regression coefficient (B)	Standard error (SE)	Sig.	Relative chance	Confidence interval 95%	
						Lower limit	Upper limit
Skinny	Favorable	0.136	0.269	0.613	1.146	0.676	1.941
	Unfavorable	Reference group			1		
Overweight	Favorable	-0.213	0.168	0.205	0.809	0.582	1.123
	Unfavorable	Reference group			1		
Obese	Favorable	-0.344	0.173	0.047	0.709	0.505	0.995
	Unfavorable	Reference group			1		

According to **Table 4**, an indirect relationship exists between favorable sleep and obesity (P=0.04), so favorable sleep would reduce the possibility of obesity by 0.7 times (CI:95% OR:0.7, 0.505-0.995).

Table 5. Estimation of regression coefficients of factors related to BMI based on the stress using Multinominal logistic regression model

BMI status	Stress area	Regression coefficient (B)	Standard error (SE)	Sig.	Relative chance	Confidence interval 95%	
						Lower limit	Upper limit
Skinny	Loss of appetite	0.624	0.192	0.001	1.867	1.282	2.719
Overweight	Loss of appetite	-0.405	0.134	0.002	0.667	0.513	0.866
Obese	Loss of appetite	-0.735	0.151	0.0001	0.48	0.357	0.645

Table 5 indicates that in the stress area, loss of appetite is the most important factor related to thinness (P=0.001), overweight (P=0.002), and obesity (P=0.0001) so that increased loss of appetite (from 0=never to 3=always) would increase the possibility of thinness by 1.8 times greater than individuals with normal weight (CI:95% OR:1.86, 1.2-2.7). Moreover, this table indicates that increased loss of appetite would reduce the possibility of overweight and obesity by 0.67 and 0.48 times, respectively greater than individuals with normal weight.

Results and Discussion

The results indicate that drinking the juice prepared at home (P=0.01) is one of the factors predicting overweight, so drinking it would increase the possibility of overweight by 2.65 times greater than individuals with normal weight. The results obtained by Kimiagar *et al*. indicated a direct relation between drinking organic juice and overweight (P=0.001) [26]. The study conducted on 7194 people in Spain by Rastrolebs *et al*. investigated the effect of drinking more industrial sweet drinks on the overweight. This study showed that constant use of industrial drinks leads to 0.3 kg/y weight gain [27]. Moreover, the results obtained by Vilchis *et al*. showed a significant statistical relation between drinking sweet beverages and increased risk of obesity (P<0.04) [28]. The results obtained by Boumtje indicated a significant relationship between being overweight and drinking unhealthy beverages [29]. These results are not matched with the results of the present study. The authors explain that the effect of drinking a juice prepared at home on a child's overweight may be rooted in the organic juice that is prepared using many fruits with high calories. On the other hand, excessive organic juice drinking may lead to overweight despite its organic and healthy nature.

Moreover, it was concluded that doing exercise after school may be a factor related to overweight (P=0.05), so doing exercise after school could reduce overweight by 1.4 times. In addition, regular exercise during education is a factor related to obesity (P=0.05), so regular exercise during education could reduce the possibility of obesity by 0.69 times greater than individuals with normal weight. Regular exercise during summer holidays was another factor related to obesity (P=0.05), so regular exercise during summer holidays could reduce the possibility of obesity by 0.67 times greater than normal people. In this lieu, Azarbaijani *et al*. conducted a study titled "The relation between obesity, physical activity, and socioeconomic status among girl students living in northern Tehran" examining 488 students of

the 7-11 age range. They found a significant indirect relationship between physical activity and the BMI of children at all age ranges (P<0.02). This means that a reduction in physical activity would lead to an increase in the BMI percentile of students [30].

The results showed no significant relationship between electronic entertainment and BMI. Moreover, daily TV watching is a factor associated with obesity (P=0.05), so watching TV daily would increase the possibility of obesity by 1.2 times greater than individuals with normal weight. Playing electronic games is another factor related to obesity (P=0.02), so playing ecteronic games daily increases the possibility of obesity by 0.7 times greater than individuals with normal weight (CI:95% OR:0.7, 0.6-0.9). Playing electronic games on weekends is another factor related to obesity, so playing electronic games on weekends increases the possibility of obesity by 1.2 times greater than individuals with normal weight. According to results obtained by Akhavan Karbasi *et al.*, a significant nexus exists between child obesity and overweight with the time spent watching TV (P=0.001). The results obtained by Moghimi DehKordi in Tehran indicated that daily use of computers was related to obesity (P<0.002) [31]. Ramezankhani *et al.* found a statistically significant relationship between BMI and hours spent watching TV (P=0.002) [32].

According to estimated regression coefficients of factors related to BMI based on the child's sleep status, favorable sleep has an indirect relation with obesity (P=0.04), so favorable sleep would reduce the child's obesity by 0.7 times. According to the results obtained by Yousef Gomrokchi *et al.*, most of the studied children had unfavorable sleep habits [33]. Also, results obtained by Lytle *et al.* showed that unfavorable and insufficient sleep had a positive relationship with obesity, which is in line with the results of the present study [34]. The author believes that the indirect relation between favorable sleep and obesity may be rooted in the reason that favorable sleep provides sufficient growth hormone secretion, so child growth occurs at the most suitable condition.

Moreover, the results indicated that loss of appetite is one of the factors related to thinness (P=0.001) (direct relation), overweight (P=0.002) (indirect relation), and obesity (P=0.0001) (indirect relation). In this case, increased loss of appetite (from 0=never to 3=always) increases the possibility of thinness by 1.8 times greater than in normal individuals. Also, the results indicate that increased loss of appetite would reduce the possibility of being overweight and obese by 0.67 and 0.48, respectively rather than normal individuals. The results obtained by Ahmadi *et al.* indicated a significant relationship between stress and weight loss (P<0.05), which is consistent with the results of this study [35], while results obtained by Torres *et al.* showed that stress may increase the risk of obesity and overweight [36].

Conclusion

The obtained results showed that in the area of nutritional and food habits, eating vegetable salad is one of the factors related to thinness (direct relation), and drinking juice prepared at home is a factor predicting overweight (indirect relation). The factors predicting obesity also included drinking juices prepared at home (direct relationship) and eating breakfast (indirect relationship). In the case of physical activity, the results showed that doing exercise after school is one of the factors related to overweight having an indirect relation with it. The results of electronic entertainment showed that TV watching, playing electronic games daily, and playing electronic games during weekends are factors related to obesity (direct relationship). In terms of sleep, the results indicated that longer sleep hours, when the child sleeps in the bed alone, the child's need for parents' presence when they want to sleep (direct relationship), and good appetite after waking up (indirect relationship) are some factors related to thinness. In terms of stress, the obtained results showed that loss of appetite was the single factor related to thinness, overweight, and obesity, which had a direct relation with thinness and an indirect nexus with overweight and obesity.

The results of the study can be used by health managers and planners to design screening programs associated with obesity and its implications among children and to find what lifestyle areas of children must be modified and changed.

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