Original Article

Association between lifestyle and height growth in high school students

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Abstract

Introduction: An important indicator that plays a pivotal role in examining the health of individuals living in a community is their height. The aim of this study was to examine the relationship between lifestyle and height among female high school students in Dezful, Iran. **Methods:** This research was a cross-sectional descriptive-analytical study. Participants included 351 female high school students who were selected from public and private high schools in Dezful using random cluster sampling. Miller–Smith Lifestyle Assessment Inventory was used to collect data about students' lifestyles, and their height was measured based on self-report. **Results:** The total lifestyle score of the study participants was 52.23 ± 11.31. Also, 30.2%, 67.2%, and 2.6% of the students had high, moderate, and low lifestyle scores, respectively. A negative and significant relationship was observed between the total score of lifestyle and its components, that is, nutrition, sleep, exercise, and mental stress, and the height growth of female high school students in Dezful ($P < 0.05$) according to Pearson's correlation. Results of regression analysis showed that the total lifestyle score and its components could significantly predict the height growth of students. **Conclusion:** Our results are indicative of the relationship between lifestyle and its components with height growth among female high school students.

Keywords: Adolescents, female students, height growth, lifestyle

Introduction

Adolescence is a life-changing stage in life that is associated with the growth and maturation of all organs and physiological systems. On average, adolescents aged 10 to 19 years gain 20% of their final adult height and 50% of their final adult weight at this stage.[1] There are more adolescents now than ever before in human history. Their growth period, however, is affected by important changes in lifestyle owing to factors such as rapid urbanization, climate change, a tendency toward foods that are high in calories but low in nutritional value, the epidemic of COVID-19, and the increased socioeconomic inequality.[2,3] The consequences of these changing conditions have brought about profound effects on the height and weight growth of adolescents. Today, the very low physical activity of adolescents due to lifestyle changes, their reduced mobility caused by excessive use of electronic equipment, and their improper nutrition patterns have increased the prevalence of chronic diseases such as type 2 diabetes, heart diseases, and obesity.[3]

Human growth in terms of height, weight, and other body dimensions is widely used as the most important health indicator in environmental epidemiology and public health. Social, economic, and political differences between communities are often associated with differences in the average height of these groups. This is why researchers describe human growth as a "mirror reflecting the state of society."[4] Human growth, especially height growth, is

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regulated by genes, nutrition, health, and the socioeconomic status of the individual.[5] The results of previous studies have shown that children who suffer from malnutrition have a particular illness or are of a poor socio-economic background, and usually have short stature.[5,6] Also, the results have shown that improving nutrition, public health, socio-economic status, and their lifestyle will lead to improvement in the growth of children and adolescents and their final height.[1,5-7] Therefore, an understanding of the relationship between lifestyle and adolescent height growth is essential to identify the best time to take action and avoid the potential negative consequences associated with height growth. To this aim, the present study was conducted to determine the relationship between lifestyle and height in female high school students in Dezful, Iran.

Materials and Methods

This was a cross-sectional, descriptive–analytical study investigating the relationship between lifestyle and height growth of female high school students in Dezful, Iran. After the necessary permits were obtained to conduct this study, 351 female students from public and private high schools in Dezful were recruited using the random cluster sampling method. Data related to lifestyle were collected using the Miller–Smith Lifestyle Assessment Inventory through interviews, and the height of the students was measured by self-report. The Miller–Smith Lifestyle Assessment Inventory includes 20 items in four dimensions of nutrition, sleep, exercise, and mental stress. Each item is scored based on five options (always: 1, often: 2, sometimes: 3, rarely: 4, never: 5). Higher scores indicate an unpleasant and unhealthy lifestyle. Scores within the range of 20–45, 46–75, and 76–100 indicate high, moderate, and low lifestyles, respectively.[8]

The validity and reliability of the Miller–Smith Lifestyle Assessment Inventory were confirmed by the faculty members of the Isfahan University of Medical Sciences after open translation. Its reliability in a pilot study on 20 patients with lung disease was 0.86, and Cronbach's alphas for each question were higher than 0.5.[9] The height of the students was measured by the lead researcher. After data collection, the data were analyzed using SPSS version 22.

Statistical analysis

Quantitative data are presented by mean and standard deviation, whereas frequency and percentage were used to describe qualitative variables. The data were analyzed based on statistical tests such as *t*-test, one-way analysis of variance, and Pearson's correlation coefficient using SPSS version 22.

Results

In this research, the participants included 351 high school female students, 33.2% of whom were 16 years old, 32.8% were 17 years old, and 33% were 18 years old. Also, 71% of the students were studying at public high schools, whereas 29% were recruited from private high schools [Table 1].

As can be seen in Table 2, the mean and standard deviation of the height and weight of the studied students were 161.65 ± 6.99 cm and 56.15 ± 7.48 kg, respectively.

The mean and standard deviation of the total score of lifestyle and its components are reported in Table 3, and the overall lifestyle status of the participants is shown in Table 4. According to this table, 30.2% of the students had a high lifestyle, 67.2% had a moderate lifestyle, and 2.6% had a low lifestyle.

The results of Pearson's correlation coefficient showed that there was a negative and significant relationship between the total score of lifestyle status and height growth of the participants ($P = 0.001$, $R = 0.671$). It was also observed that overall, lifestyle status accounts for 45% of height growth variances ($R^2 = 0.450$). The results of the analysis of variance (ANOVA) showed that the prediction of participants' height growth based on the total lifestyle score is significant ($F = 285.55$ and $P < 0.001$). According to the reported coefficients of the prediction equation, the total lifestyle score could significantly predict the height growth of students ($B = -0.671$ and $P < 0.001$) [Table 5].

The results of Pearson's correlation coefficient showed that there was a negative and significant relationship between nutrition and height growth of the participants ($P = 0.001$, $R = 0.527$). Because higher scores in the nutrition component indicate

Table 1: Frequency distribution of students according to age

Percentage	Frequency	Age	Variable
33.2	120	16-year-old	Age
8.32	115	17-year-old	
33	116	18-year-old	
100	351	All students	
71	249	Public	Type of high school
29	102	Private	
100	351	Total	
33	116	Governmental	Father's occupation
67	235	Self-employed	
100	351	Total	
4.3	12	Very low	Family income
39.3	138	Low	
42.7	150	Moderate	
14.5	51	High	
100	351	Total	

Table 2: Descriptive indices of the studied samples in terms of height (centimeters) and weight (kilograms)

Maximum	Minimum	SD±mean	Frequency	Variable
180	139	161.65±6.99	351	Height (cm)
81	35	56.15±7.48	351	Weight (kg)

Table 3: Descriptive indicators of the studied sample according to lifestyle status

Maximum	Minimum	SD±Mean	Frequency	Component	Variable
25	5	13.05±4.04	351	Nutrition	Lifestyle
25	6	13.56±3.90	351	Sleep	
25	5	13.32±3.96	351	Exercise	
24	5	12.29±3.85	351	Mental stress	
81	24	52.23±11.31	351	Total lifestyle score	

Table 4: Frequency distribution of the studied students according to lifestyle status

Percentage	Frequency	Lifestyle status
30.2	106	High (20-45)
67.2	236	Moderate (46-75)
2.6	9	Low (76-100)
100	351	Total

inappropriate and unhealthy nutrition, it can be argued that the better the nutritional status, the higher the students' height growth and vice versa. It was also observed that nutritional status explains 27.7% of the height growth variances of the participants ($R^2 = 0.277$). The results of ANOVA showed that the prediction of participants' height growth based on nutritional status is significant (F = 133.9 and $P < 0.001$). According to the reported coefficients of the prediction equation, nutritional status could significantly predict height growth (B = −0.527 and $P < 0.001$) [Table 6].

The results of Pearson's correlation coefficient showed that there was a negative and significant relationship between sleep and height growth of participants ($P = 0.001$, $R = 0.432$). Because higher scores in sleep indicate inappropriate and unhealthy sleep patterns, improved sleep patterns are associated with higher height growth rates, and vice versa. It was also observed that sleep status explains 18.7% of the variances in students› height growth ($R^2 = 0.187$). The results of ANOVA showed that the prediction of the height growth of students based on sleep status was significant (F = 1.80 and $P < 0.001$). According to the reported coefficients of the prediction equation, sleep status could significantly predict height growth (B = −0.432 and $P < 0.001$) [Table 7].

The results of Pearson's correlation coefficient showed that there was a negative and significant relationship between exercise and height growth of the participants ($P = 0.001$, $R = 0.472$). Because higher grades in exercise indicate inappropriate and unhealthy exercise, the more the condition of exercise is improved, the higher the height growth will be, and vice versa. It was also observed that exercise explains 22.3% of the variances in height growth of students ($R^2 = 0.322$). The results of ANOVA showed that the prediction of height growth of female students based on exercise was significant ($F = 1.100$ and $P < 0.001$). According to the reported coefficients of the prediction equation, exercise could significantly predict the height growth of students (B = −0.472 and $P < 0.001$) [Table 8].

The results of Pearson's correlation coefficient showed that there was a negative and significant relationship between mental stress and height growth of the participants ($P = 0.001$, $R = 0.494$). Because higher scores in mental stress indicate more mental pressure, the students› reduced mental stress was associated with higher height growth and vice versa. It was also observed that mental stress accounts for 24.2% of the variances in students› height growth ($R^2 = 0.242$). The results of ANOVA showed that the prediction of height growth of students based on mental stress was significant (F = 112.7 and $P < 0.001$). According to the reported coefficients of the prediction equation, mental stress could significantly predict height growth (B = -0.494 and $P < 0.001$) [Table 9].

Discussion

According to the results of the present study, the total score of lifestyle and its components, including nutrition, sleep, exercise, and mental stress had a negative and significant relationship with the height growth of female high school students in Dezful, Iran. According to the Miller–Smith Lifestyle Assessment Inventory, higher scores in lifestyle and its components indicate an unpleasant and unhealthy lifestyle. In the present study, we observed that lower scores in the students' lifestyle scores, which represent a better lifestyle, are associated with higher height growth rates among these students. In other words, our results showed that the total lifestyle score could significantly predict the height growth of students. Consistent with the results of the present study, Hermanussen *et al.* (2015)[10] stated that due to the reduced everyday physical activities, individuals' skeleton has become thinner, and in addition to changes in skeletal morphology, height has also decreased in countries including Germany. In other studies, it has been reported that the decrease in physical activity along with the mechanization of everyday life has caused reduced elbow width among children.[11,12] In Japan, in contrast, these changes have been in a different direction. Due to the modification of lifestyle, food patterns, and genetic makeup in this country, the height of individuals has relatively increased at every age.[10] As mentioned earlier, dietary styles and physical activity are important factors affecting adolescent growth during puberty; however, it should be born in mind that not only does low physical activity has negative effects on adolescent growth but also sports reinforcing strict weight control, and high energy production may also lead to developmental disorders. Malnutrition is one of the most common causes of growth restriction worldwide.[13] Sleep is another factor affecting growth. In Zhou *et al.*'s (2015)[14] study, sleep duration was significantly

Table 5: Correlation between total lifestyle score and height growth

Correlation matrix of the relationship between the total lifestyle score and height growth								
Height growth							Frequency	Variable
				P	Pearson's correlation coefficient *R*			
				0.001	-0.671		351	Total lifestyle score
Results of the regression analysis of predicting the height growth of students based on the total lifestyle score								
P	Coefficients		ANOVA		Model summary		Predicting variable	Criterion variable
	t	*B*	*P*	*F*	R^2	*R*		
0.001	-16.89	-0.671	0.001	285.5	0.450	0.671	Total lifestyle score	Height growth

Table 6: Correlation between total nutrition score and height growth in participants

Correlation matrix of the relationship between the total nutrition score and height growth								
Height growth							Frequency	Variable
				P	Pearson's correlation coefficient *R*			
				0.001	-0.527		351	Total nutrition score
Results of regression analysis of predicting height growth of students based on total nutrition score								
P	Coefficients		ANOVA		Model summary		Predicting variable	Criterion variable
	t	*B*	*P*	*F*	R^2	*R*		
0.001	-11.57	-0.527	0.001	133.9	0.277	0.527	Nutrition	Height growth

Table 7: Correlation between total sleep score and height growth

Correlation matrix of the relationship between total sleep score and height growth								
Height growth							Frequency	Variable
				P	Pearson's correlation coefficient *R*			
				0.001	-0.432		351	Total sleep score
Results of regression analysis of predicting height growth of students based on total nutrition score								
P	Coefficients		ANOVA		Model summary		Predicting value	Criterion variable
	t	*B*	*P*	*F*	R^2	*R*		
0.001	-8.95	-0.432	0.001	80.91	0.187	0.432	Sleep	Height growth

Table 8: Correlation between the total score of exercise and height growth

Correlation matrix of the relationship between the total score of exercise and height growth								
Height growth							Frequency	Variable
				P	Pearson's correlation coefficient *R*			
				0.001	0.472		351	Total score of exercise
Results of the regression analysis of predicting the height growth of students based on the total score of exercise								
P	Coefficients		ANOVA		Model summary		Predicting variable	Criterion variable
	t	*B*	*P*	*F*	R^2	*R*		
0.001	0.110	0.472	0.001	0.110	0.223	0.472	Exercise	Height growth

associated with height. In Malay children, shorter sleep was associated with higher body mass indexes (BMIs) and shorter heights. In addition, sleeping less than 12 h per day at 3 months of age was associated with higher BMIs and shorter heights in children. In general, growth rates of height, weight, and other body dimensions are widely used as health indicators in environmental epidemiology and public health studies. Social, economic, and political differences between human groups lead to mean height differences in these groups.[15]

Studies have also shown that factors such as nutrition, infection, and other diseases, mental and emotional state, heredity, as well as genetic and epigenetic changes, affect height growth.[16-18] Some of these growth regulators affect the growth hormone/

Table 9: The relationship between the total score of mental stress and height growth

Correlation matrix of the relationship between the total score of mental stress and height growth								
Height growth							Frequency	Variable
				P	Pearson's correlation coefficient *R*			
				0.001	-0.494		351	Total score of mental stress
The results of regression analysis of predicting height growth of students based on the total score of mental stress								
P	Coefficients		ANOVA		Model summary		Predicting variable	Criterion variable
	t	*B*	*P*	*F*	R^2	*R*		
0.001	-10.62	-0.494	0.001	112.7	0.242	0.494	Mental stress	Height growth

insulin-like growth factor-1 (GH/IGF-1) axis directly or indirectly by affecting pathways that alter the physiology of glucocorticoids and insulin.[15] Hermanussen and Aßmann (2013) observed that growth hormone and insulin-like growth factor-1 (IGF-1) activity is affected by various biological, social, and emotional factors through complex interactions. These researchers stated in their study that human growth, especially height growth, is regulated by genes, nutrition, health, and the state of the individual's social and economic environment and that under favorable physical conditions, individuals are believed to achieve their full genetic potential.[19]

Previous studies by a number of researchers have shown that the change in lifestyle followed by the increased prevalence of obesity in developing societies is associated with children's restricted height growth. It has also been reported that lifestyle changes such as increased access to low-cost foods with low nutritional value (high in sugar and fat) and high calories play an important role in the progressively increasing obesity epidemic in these societies.[20] However, other factors related to socioeconomic status, such as exposure to cigarette smoke (in utero and after birth),[21] reduced physical activity[22], and inappropriate sleep patterns,[23] also play an important role in obesity and overweight. As mentioned above, the growth hormone plays a vital role in the height and physical growth of children, and it is maximally released during sleep, and after feeding and doing exercise.[24] Therefore, it seems that reduced activity, unhealthy nutrition, and improper sleep patterns can directly affect growth hormones, and by bringing about overweight and obesity, they can also affect the height growth and body composition of children.[24] It has been reported that secretion of growth hormone either spontaneously or as a result of stimulating stimuli is significantly impaired in obese people.[25] In a study on overweight and obese people, for instance, it was observed that the growth hormone response to the growth hormone-releasing factor has an inverse relationship with the percentage of ideal body weight.[26] Compared to people with normal weight, overweight and obese people have been characterized by a reduced half-life of growth hormone and a decrease in the frequency of growth hormone secretory episodes and their daily production. In addition, in obese people, growth hormone secretion in response to all stimuli affecting the hypothalamus (that is, hypoglycemia caused by insulin, arginine, galanin, L-dopa, clonidine, and acute glucocorticoid administration) and somatotroph stimulation caused by external growth hormone-releasing hormone (GHRH) is disrupted.[25] In general, the disruption in the response of growth hormones to various stimulating factors during obesity and under the influence of metabolic and nutritional factors has been well documented. In addition, it has been observed that drugs capable of preventing lipolysis, and thereby reducing non-esterified fatty acids (NEFA), significantly improve growth hormone secretion in obese people. Reducing the intake of calories and losing weight have also been mentioned as two measures to normalize the secretion of growth hormones. In general, it seems that factors related to the hypothalamus, the pituitary, and the environment play a role in reducing growth hormone secretion following obesity.[27] The results of the current study as well as those of previous studies confirm the role of lifestyle and its components, including sleep pattern, nutrition, physical activity, and mental stress on children's height growth. Therefore, it seems that modifying lifestyles and educating parents in this regard play a significant role in improving the height growth pattern of adolescents.

Conclusion

The total lifestyle score of female high school students living in Dezful was 52.23 ± 11.31. Of these students, 30.2% had a high lifestyle, 67.2% had a moderate lifestyle, and 2.6% had a low lifestyle. Pearson's correlation showed that the total score of lifestyle and its components, including nutrition, sleep, exercise, and mental stress had a negative and significant relationship with the height growth of female high school students in Dezful city. Based on the results of regression analysis, the total lifestyle score could significantly predict the height growth of students. In other words, improvement in student's lifestyle and its components is associated with higher height growth.

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Conflicts of interest

There are no conflicts of interest.

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