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The association between body mass index and health literacy in high school Students: A cross-sectional study

Mohammad Reza Zare-Zardiny[1], Faroukh Abazari[2,3], Mohammad Ali Zakeri[4,5], Majid Dastras[6], Jamileh Farokhzadian[7]

[1]Research Center for Nursing and Midwifery Care, Shahid Sadoughi University of Medical Sciences, Yazd, Iran, [2]Health in Disasters and Emergencies Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran, [3]Department of Community Health Nursing, Razi Faculty of Nursing and Midwifery, Kerman University of Medical Sciences, Kerman, Iran, [4]Non-Communicable Diseases Research Center, Rafsanjan University of Medical Sciences, Rafsanjan, Iran, [5]Social Determinants of Health Research Centre, Rafsanjan University of Medical Sciences, Rafsanjan, Iran, [6]Department of Nursing, Faculty Member of Zahedan University of Medical Sciences, Zahedan, Iran, [7]Nursing Research Center, Kerman University of Medical Sciences, Kerman, Iran

Address for correspondence:
Dr. Jamileh Farokhzadian, Razi Faculty of Nursing and Midwifery, Kerman University of Medical Sciences, Haft-Bagh Highway Kerman, Iran.
E-mail: j.farokhzadian@kmu.ac.ir; farokhzadian2010@yahoo.com

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Abstract:

BACKGROUND: Obesity and overweight in children and adolescents have become a global problem in recent years. Adolescence increases the likelihood of obesity in adulthood and associated illnesses. Nowadays, health literacy is one of the greatest determinants of the health. This study was conducted to evaluate the correlation between body mass index (BMI) and health literacy in high school students.

MATERIALS AND METHODS: In this descriptive-analytical study, 430 high school students were enrolled in a multi-stage random method in Yazd city in the center of Iran. The data were collected through The Health Literacy Measure for Adolescents and calculate BMI with measurement of height and weight of adolescents. The data were then analyzed using SPSS 25 and descriptive and inferential statistics (Chi-square and multivariate regression).

RESULTS: The results showed that the mean score of BMI (21.76 ± 3.76) was in a normal range. The score of health literacy was at the borderline level (58.44 ± 13.79). BMI was not significantly correlated with health literacy ($P = 0.09$). BMI was significantly different in terms of age, high school grade, school type, and health status. School type and health status predict 37% of the variance of BMI ($R^2 = 37\%$) and the best predictor was health status ($P < 0.05$).

CONCLUSIONS: The results of the present study showed that BMI was not correlated with health literacy and student health literacy was at the borderline level. It is necessary to carry out further studies on the causes and facilitators and the barriers to increasing health literacy. Furthermore, educational interventions are needed to prevent the increase of BMI in adolescents and identify determining factors.

Keywords:

Body mass index, health, high school, literacy, obesity, students

Introduction

Obesity is a major health problem worldwide. The World Health Organization defines adolescents' obesity and overweight as an epidemic crisis in developed and developing countries.[1] Overweight and obesity in childhood and adolescence increase the risk of obesity in adulthood.[2] Obesity and overweight are influenced by genetic factors, individual factors, nutritional behaviors, reduced physical activity, social, economic, and cultural factors such as knowledge and attitude.[3] Obesity is a risk factor for cardiovascular disease, diabetes, various types of cancers, liver disease, and high blood pressure. In addition, obesity can increase depression, avoidance, reduce self-esteem, impose economic costs, and increase mortality.[4] The body mass index (BMI) is the most common method for the assessment of obesity. Therefore, BMI ≥25 shows overweight and BMI ≥30 shows obesity.[5] According to a study in the US, the prevalence of obesity in U.S. children

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and adolescents aged 2–19 years was 19.3%.[6] In Iran, the prevalence of overweight and obesity was 4.4%–42.3% and 1%–16.1%, respectively.[7]

Several factors can affect obesity and overweight people. Health literacy is one of these possible factors that has been mentioned in studies.[8,9] Health literacy is the individuals' capacity to obtain, interpret, and understand basic information and health services[10] that are needed for proper decision-making.[11] Inadequate health literacy is accompanied by adverse health conditions, inappropriate use of medication, failure to follow doctor's orders, the increasing illness; less health knowledge, the increasing risk of hospitalization, poorer ability to demonstrate taking medications appropriately, and poorer ability to interpret labels and health messages.[12,13] Health literacy is a global issue and debate as well as one of the greatest determinants of the health.[14,15]

Adolescence is one of the most challenging periods in human life, and is an important transition from childhood to adulthood with the most profound personality and physiological changes. Adolescence is an infinitely important stage in relation to health, since many of the habits and behaviors formed at this stage are sustained in the middle ages.[16,17] Students spend most of their time in school. Therefore, schools play an important role in health promotion behaviors such as promoting healthy eating, physical activity, and health education.[18-20] Community health nurses, as health educators, play an important role in improving the health of students in schools.[21,22] Health literacy is very important in adolescents since they gain more health information through electronic communication networks, and much of this information is uncertain.[17] Improving adolescent's health literacy is important because healthy behaviors and habits are formed in adolescence and adolescents are the future clients of the health system. Therefore, adequate health literacy reduces the adverse effects on health, and inadequate health literacy increases risk behaviors.[23,24]

Several studies investigated the relationship between health literacy and BMI. For example, Sharif and Blank showed a reverse relationship between the health literacy and BMI in adolescents.[8] Lam and Yang showed that students with lower health literacy had a higher BMI than other students.[25] A study in Iran showed a direct correlation between the health literacy and nutritional performance in adolescents.[16] Although some studies have been conducted, they are inadequate and the relationship between the health literacy and BMI in Iranian adolescents and those in other countries has been underestimated. Therefore, the current study aimed to evaluate the correlation between BMI and health literacy in high school students.

Materials and Methods

Study design and setting

This descriptive-analytic study was carried out in high schools of Yazd located in the center of Iran. The current study investigated the relationship between BMI and health literacy and some influential factors in students in 2018. It is noteworthy that the Iranian educational system changed in 2012. In this system, the middle and high schools have been shifted into the first and second periods. There are three grades in the first period and three grades in the second period.

Study participants and sampling

The target population of this study included high school students at the time of data collection (N = 20000). The Cochran formula ($\alpha = 0.05$, $d = 0.05$, $Z = 1.94$) was recruited and the sample size was estimated to be $n = 405$. Considering a 6% drop out probability, 430 students were selected using the randomized three-stage cluster-sampling method.

$$N = \frac{N(Z_{a/2})^2 p_q}{(N-1)\mathrm{D}^2 + PQ(Z_{a/2})^2}$$
$$= \frac{20000 \times (1.96)^2 \times 0.25}{19999 \times (0.05)^2 + 0.25 \times (1.96)^2} = 405$$

Given that Yazd consists of two educational districts, each district was considered as one cluster. Schools were divided into governmental and nongovernmental groups, then boys and girls (female and male schools are separate in Iran). After identifying the list of schools in each district and extracting their names, samples were selected randomly. The inclusion criteria included male and female high school students aged 15–19, who have been living in Yazd for 5 years and were willing to participate in the study. Exclusion criteria included those who lost or did not complete the questionnaire.

The researchers referred to the schools after obtaining a code of ethics from the ethics committee. After selecting the eligible students, clarifying the purpose of the study, and obtaining written consent from the students, the students completed the questionnaire, and BMI was measured in students. Forty hundred and thirty questionnaires were distributed in 6 months (November 2017 to May 2018), and seven students were excluded from the study due to incomplete questionnaires. Finally, data from 423 participants were used in the final analyses (response rate = 98%).

Data collection tool and technique

In this study, three tools were used for data collection. The first questionnaire was used to collect demographic

information of participants such as their age, gender, high school grade, school type, field of study, being interested in health issues, health status, and source of health information [Table 1].

The second one is the digital SEKA scale and the graded portable rod. The samples' weights were measured and recorded in the morning with light clothes without shoes and with correct standing position. The heights of the research units were measured and recorded without shoes and with correct standing position (stand with your feet flat on the floor with your heels against the corner where the wall and floor meet. Make sure your head, shoulders, and buttocks are touching the wall. Stand up straight with your eyes looking straight ahead). BMI was calculated by using the weight formula in kilograms divided by the height square in meter. Accordingly, individuals with a BMI <18.5 were underweight, those with BMI of 18.5–24.9 were normal and those with BMI of 25–29.9 were overweight and those with BMI >30 were obese.[24]

The Health Literacy Measure for Adolescents (HELMA) is the third questionnaire. The HELMA is a valid and reliable tool for the measurement of the health literacy of adolescents aged 15–18. Ghanbari *et al*. prepared and validated this questionnaire.[24] The questionnaire consisted of 44 items in eight subscales of self-efficacy (items 1–4), access (items 5–9), reading (items 10–14), understanding (items 15–24), appraisal (items 25–29), use (items 30–33), communication (items 34–41), and numeracy (items 42–44). The five point Likert scale was used: never (1 point), rarely (2 points), sometimes (3 points), most often (4 points) and always (5 points), but in the numeracy, the score is between 0 and 1. In this way, the correct answer is score one and the wrong answer is score zero. The score for this questionnaire is between 41 and 208, but according to the authors, the total score of the questionnaire was between 0 and 100 based on a specific formula. Accordingly, Students' health literacy is ranked in four inadequate (0–50), borderline (50.1–66), sufficient (66.1–84), and excellent levels (84.1–100).

Table 1: Students demographic information and its relationship with body mass index and health literacy scores (*n*=423)

Variables	Categories	Frequency *n* (%)	Health literacy		BMI	
			Mean±SD	Statistical test/*P*	Mean±SD	Statistical test/*P*
Age (years)	-	423 (100)	16.82±0.89	*r*=−0.143	21.76±3.76	*r*=0.11
				P=0.004*		*P*=0.01*
Gender	Male	203 (48)	17.15±2.88	*t*=2.54	22.02±4.17	*t*=−1.36
	Female	220 (52)	17.83±2.86	*P*=0.01*	21.52±3.33	*P*=0.17
High school grade	First	153 (36.2)	17.79±2.89	*F*=3.91	21.74±4.02	*F*=3.72
	Second	139 (32.8)	17.77±2.95	*P*=0.02*	21.17±3.48	*P*=0.02*
	Third	131 (31)	16.94±2.79		22.41±3.66	
School type	government	354 (83.7)	17.44±2.89	*t*=1.51	21.56±3.74	*t*=6.10
	Non-government	69 (16.3)	17.91±2.87	*P*=0.21	22.78±3.74	*P*=0.01*
Field of study	Experimental	131 (31.0)	17.79±3.17	*F*=3.26	21.57±3.68	*F*=0.65
	Mathematics	129 (30.5)	17.61±2.64	*P*=0.02*	22.09±3.64	*P*=0.57
	Humanities	133 (31.4)	17.52±2.82		21.55±3.88	
	Technical	30 (7.1)	15.99±2.53		22.09±4.17	
Interested in health issues	Not interested	27 (6.4)	14.86±3.23	*F*=14.14	21.50±4.92	*F*=0.29
	Little	51 (12.0)	16.31±2.74	*P*=0.00*	22.27±3.86	*P*=0.91
	Somewhat	172 (40.7)	17.26±2.61		21.62±3.75	
	Much	109 (25.8)	18.13±2.67		21.87±3.66	
	Very much	64 (15.1)	19.26±2.64		21.65±3.44	
Health status	Very good	151 (35.7)	18.2±2.86	*F*=5.81	21.43±3.80	*F*=3.70
	Good	196 (46.3)	17.43±2.75	*P*=0.00*	21.53±3.64	*P*=0.00*
	Fair	66 (15.6)	16.61±2.93		22.86±3.72	
	Poor	8 (1.9)	14.98±3.17		23.10±2.89	
	Very poor	2 (0.5)	15.43±1.14		28.25±8.87	
Source of health information	Teacher	12 (2.8)	18.28±2.05	*F*=2.15	22.69±3.93	*F*=1.59
	Parent	202 (47.6)	17.18±2.89	*P*=0.04*	21.32±3.53	*P*=0.14
	Physician	126 (29.8)	18.11±2.74		22.28±4.14	
	Internet	62 (14.7)	17.43±3.18		22.31±3.74	
	Health provider	7 (1.7)	16.50±3.06		20.99±2.01	
	Friend	7 (1.7)	16.07±2.37		21.54±3.69	
	Book	7 (1.7)	18.67±2.56		19.76±3.34	

*The significant variables, Data were presented as *n* (%). The sample consisted of 430 students with mean age 16.82±0.89 years. SD=Standard deviation, BMI=Body mass index

$$\frac{\text{Raw score - Minimum passible raw score}}{\text{Maximum passible raw score - Minimum passible raw score}} \times 100$$

Content validity of HELMA was determined by content validity ratio (CVR) and content validity index (CVI). Expressions with at least CVR of 0.54 and phrases containing CVI < 0.79 were deleted in HELMA. Finally, the average CVI was 0.93. Reliability of HELMA was confirmed with a Cronbach alpha coefficient of 93%.[24]

The data were analyzed in SPSS 18 (Inc., Chicago, IL, USA) using descriptive statistics (frequency, percentage, mean, and standard deviation) and inferential statistics (independent *t*-test, analysis of variance [ANOVA]). Furthermore, the BMI and health literacy scores had normal distributions, so the Pearson correlation coefficient was used to determine the correlation between BMI and health literacy. Univariate and multivariate linear regressions were used to determine the predictors of BMI. The significance level was considered at 0.05.

Ethical consideration

This research was approved by Ethics Committee of Kerman University of Medical Sciences (Code: IR.KMU.RIC.1395.582). The researcher, after obtaining the necessary permission to attend the schools, introduced the purpose of the research, obtained written consent, assured participants that the information would be confidential, and unnamed (especially height and weight information). The questionnaire was distributed and immediately collected. An unnamed female attended in female schools to reduce some gender concerns.

Results

The results showed that the mean age of students was 16.82 ± 0.89. About 52% of the students were female, 83.7% of them were studying in governmental schools with 36.2% in the first grade and 31.4% in humanities field. About 40.7% of them were interested in health issues, 46.3% had good health status, and parents of 47.8% of them were the first source of the health information [Table 1].

The mean BMI of the students was at normal level (21.76 ± 3.76(. About 57.4% of the students had a normal weight, 22% were underweight, 17.3% were overweight and 3.3% were obese. The results showed weak correlation between BMI and age (r = 0.11, P = 0.01). Table 1 shows significant differences in BMI based on age, high school grade, school type, and health status assessment so that the mean BMI of the third grade girls with poor health status in nongovernmental high schools was more than other variables.

The mean score of students' health literacy was at borderline level (58.44 ± 13.79). The highest mean health literacy score was associated with "understanding" subscale and the lowest was associated with "the appraisal" subscale [Table 2 and Figure 1]. Based on the results, 43% of the students had borderline health literacy, 27.2% had adequate health literacy, 26.7% had inadequate health literacy and only 1.3% had high health literacy.

The results of Table 1 show a negative poor correlation between health literacy and age so that the older the age, the lower the level of health literacy (r = −0.14, P < 0.000). In addition, significant differences were found in health literacy based on gender, grade, field of study, being interested in health topics, health status assessment, and source of health information. Table 1 shows all significant differences. The first grade girls in the experimental filed had higher mean health literacy than other groups.

The results showed no statistically significant correlation between BMI, health literacy and its subscales (r = −0.08, P = 0.09). One-way ANOVA showed a significant difference in health literacy based on BMI categories, so that participants with low health literacy have higher BMI (F = 5.03, P = 0.02).

Multiple regression models were tested to explore the predictive power of underlying variables of BMI such as age, school type, health status, and health literacy. The result of Table 3 indicates that school type and health status predict 37% of the variance of BMI (R^2 = 37%) and the best predictor is health status (β = 0.126, P < 0.001). The other variables were not effective.

Discussion

Present results showed no statistically significant correlation between BMI and health literacy. However, a statistically significant difference was found in health literacy based on BMI categories, so that obese students had lower health literacy. In Liao's *et al*. study, children with higher health literacy were less likely to be obese and overweight.[14] In the Cunha's *et al*. study, participants with inadequate health literacy had a higher BMI and those with high health literacy had a lower BMI.[5] Another study showed a negative and poor correlation between the health literacy and BMI.[8] One study showed no significant correlation between the health literacy and BMI in the elderly.[26] The reason for this difference can be attributed to the characteristics of participants, such as different age groups. Furthermore, the study should refer to the specific circumstances of this

Table 2: The mean of health literacy score and its subscales in participants (*n*=430)

Subscales	Minimum raw score	Maximum raw score	Minimum score	Maximum score	Mean±SD
Self-efficacy	4	20	0	100	56.69±17.19
Access	5	25	0	100	56.82±19.3
Understanding	5	25	7.5	100	66.85±18.13
Appraisal	10	50	0	100	53.90±18.71
Use	5	25	0	100	54.07±21.96
Communication	4	20	6.25	100	57.76±17.56
Numeracy	8	40	0	100	59.73±40.71
Reading	0	3	0	100	61.56±23.05
Total	0	100	12.29	94.53	58.44±13.79

SD=Standard deviation

Table 3: Multiple regression analysis summary for underlying variables of body mass index whit age, school type, health status, and health literacy in participants (*n*=430)

Variable BMI	*B*	SE	β	*t*	*P*	95% CI		R^2
						Lower	Upper	
Constant	14.13	3.77	-	3.74	0.000	6.72	21.55	36%
Health status	0.60	0.23	0.12	2.54	0.011	0.13	1.07	
School type	1.18	0.48	0.11	2.41	0.016	0.22	2.14	
Age	0.35	0.20	0.08	1.71	0.088	−0.05	0.76	
Health literacy	−0.04	0.06	−0.03	−0.73	0.465	0.18	1.10	

CI=Confidence interval, BMI=Body mass index, SE=Standard error

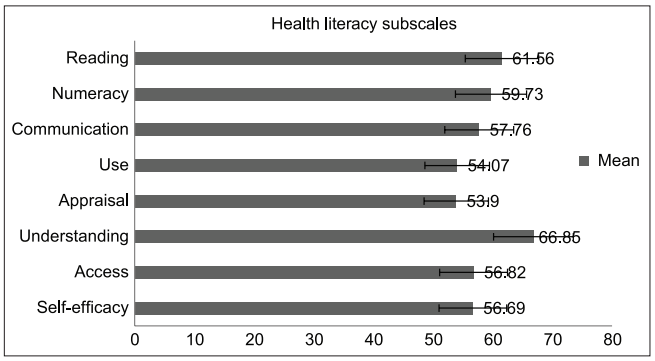

Figure 1: The mean of health literacy score among study participants

age group as the students were preparing to participate in the entrance exam, which is very important for both students and their parents. They were also stressful and had the least mobility. It should be noted that obesity and health literacy are affected by various factors which we did not address in this study. Further studies with larger sample sizes are recommended.

In the present study, BMI of most students was normal (57.4%). The results showed that the mean BMI of the third grade girls in nongovernmental high schools with very poor health status was more than other variables. Students in nongovernmental schools may have better economic status and nutrition than those in governmental schools. A poor significant relationship was found between age and BMI. Based on the results of various studies, the prevalence of overweight and obesity in adolescents has been reported differently in Iran and other countries. In the Liao's *et al*. study in Taiwan, 40% of the participants were overweight and obese.[14] According to Lam and Yang in China, 8.2% of the Chinese samples,[25] and according to Lima *et al*. 15.3% of the students suffered from obesity or overweight.[27] These different results may be due to lifestyle such as the type of nutrition, physical activity, and cultural economic context.

Present results showed that the health literacy of students was at borderline level and 26.7% had inadequate literacy. In Iran, several studies[16,24,28] reported similar results. The mean health literacy has been reported differently in the results of several studies. For example, Linnebur and Linnebur assessed the American adolescent health literacy using the newest vital sign questionnaire, and found that 12.6% of the students had inadequate health literacy.[29] Lam and Yang in China used Short Of Function Health Literacy Adult, and showed that 9.1% of students had low health literacy.[25] We did not find a study comparing health literacy in Iran with other countries, but differences in the results can be attributed to the use of different data collection tools, the number of different study samples, as well as different age groups, social and cultural status of the participants.

The results showed a very poor negative correlation between health literacy and age and age is the best predictor of health literacy. In addition, the first grade girls in the experimental filed had higher mean health literacy than other groups. The higher health literacy of girls in the experimental filed may be due to specific courses such as biology and health lessons. In addition, a significant difference was found in health literacy based on interest in health topics and health assessment. Uysal *et al*. showed health education were significantly associated with the health literacy level.[30] The results of previous studies have reported differences in health literacy based on demographic variables. Cunha *et al*. showed the health literacy in men was higher than that of women.[5] Linnebur and Linnebur did not show any difference in the health literacy between girls and boys.[29] Such discrepancy in the results may be due

to the different socio-cultural conditions and levels of education of participates in various studies.

Limitations

There were several limitations in this study. The cross-sectional nature of this study did not allow cause and effect relationship between BMI, health literacy, and other variables. Generalization of results to type of school is difficult because most participants were studying in government schools in the present study, we examined the relationship between BMI and health literacy in high school students and did not have access to other adolescents who had left school. Self-reporting and lack of similar studies were other limitations of this study. Due to various factors affecting the BMI and health literacy of school students, further national and international studies are needed to identify cultural and social differences.

Conclusions

This study showed that no statistically significant correlation between BMI and health literacy. Due to the fact that several factors can affect the BMI and health literacy of high school students, so future studies in this regard are needed. Furthermore, students' health literacy was at the borderline level and their BMI was normal. Therefore, health educational interventions seem necessary to improve health literacy and prevent the increase of BMI in adolescents.

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Conflicts of interest

There are no conflicts of interest.

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