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An investigation on the Effect of Health Belief Model-based Education on Preventive Behaviors of Diabetes Type 2 in Male Adolescences

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ABSTRACT

Aims The prevalence of Diabetes type 2 has been increased significantly during recent years. So, prevention is necessary from adolescence. This study aimed to investigate the effect of Health Belief Model-based education on preventive behaviors of Diabetes type 2 in male adolescences.
Materials & Methods This semi-experimental study was conducted on 208 secondary school students of Hamadan city (104 students in an experimental group and 104 students in a control group) in 2018, who were selected using the stratified-proportional sampling method. Data were collected using a researcher-developed questionnaire including demographic, awareness, model constructions, and preventive behavior. Afterward, an educational intervention was implemented in the experimental group based on Health Belief Model in four 45-60 minute sessions. After one month, the data were recollected from the two groups and analyzed using Chi-square, t-test, and linear regression by SPSS 16 software.
Findings Comparing the scores of awareness, Health Belief Model constructs, and student's preventive practices revealed no statistically significant differences between the two groups at the beginning of the study ($p>0.05$). However, after the intervention, significant differences were observed between the two groups regarding awareness, the Health Belief Model constructs, and student's preventive practices ($p<0.05$). Linear regression analysis indicated that self-efficacy was the most important independent predictor of type-2 diabetes-preventative behavior ($p<0.05$).
Conclusion Health Belief Model-based education is effective in promoting type-2 diabetes prevention behaviors in students.

Keywords Health Belief Model; Diabetes Mellitus, Type 2; Prevention and control; Adolescent

CITATION LINKS

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Introduction

Adolescence is an important stage of growth and development, accompanied by physical changes, new needs, and independence. Adaptation to this course is associated with behavioral challenges. According to studies, in addition to physiological changes, adolescents' lifestyles such as inactivity and low physical activity, unhealthy eating patterns [1, 2], overweight and obesity [3-6], technological life combined with stress can expose them to diabetes and reduce their quality of life [7].

Diabetes mellitus (DM) is the most common systemic metabolic disorder, the major health problem globally, responsible for 9% of all deaths in the world [8]. According to the International Diabetes Federation, in 2019, about 463 million people worldwide have diabetes, which is estimated to increase to more than 700 million by 2045, of which more than half a million are children and adolescents [9]. The prevalence of type 2 diabetes (T2D) has also been growing in Iran, while almost half of the population is unaware of their disease, and therefore it is referred to as a silent epidemic [10]. T2D accounts for 90% of all cases of diabetes [11], Neuropathy, retinopathy, diabetic foot, disability, increased mortality, and huge costs for families and health system and as one of the main concerns, Health systems are important [12].

Diabetes Type 2 is the second most common chronic disease in adolescents, 10-19 years old, while only 21% of adolescents can effectively control blood sugar [13]. After developing diabetes in adolescents, it can reduce their potential for successfully managing the disease and impair their normal growth [14]. Furthermore, parents face many challenges in managing the disease because adolescents want to increase their autonomy. Follow-up and management of diabetes require constant planning and monitoring [15]. In health care, it has recently focused on adolescents' physical, mental, and psychological well-being and emphasized that they should take more responsibility in promoting their health [1].

Evidence has shown that education about diabetes is a key principle in reducing the incidence and complications of this disease [16]. For example, educating middle and high school students could increase their awareness of diabetes [17]. Furthermore, Holder *et al.* about campaign awareness [18] and the behavior model of Hariawan *et al.* [19] showed that these interventions could improve Diabetes Mellitus prevention behavior in students.

Educational effectiveness depends on the appropriate use of behavioral science theories [20]. The purpose of presenting different educational models is to help identify and understand the factors affecting behavior and determine how these factors work. If it is taught to people based on a model and educational model, it will increase the study's effectiveness and increase its effectiveness [21]. In health education, various models have been designed to change harmful behaviors in society. The health belief model is one of the most influential theories about health-related behaviors. According to this model, people respond well to health messages and disease prevention when they feel they are at risk (perceived sensitivity), their threat is very serious (perceived severity), perceive behavior change has many benefits for them (perceived benefits) and can remove existing barriers to health behaviors (perceived barriers), in which case interventions and training programs are likely to be effective [22, 23].

This study is important in several ways: First, due to the high prevalence of diabetes in adolescents, this disease can be prevented by changing lifestyle-related behaviors. Second, less attention is paid to the education of chronic disease prevention in schools. Third, disease prevention is not a cost but an investment for the future and prevents many physical, mental, psychological, economic, and other complications. The innovative aspect of this study is related to this point that boys are less involved in the behavior change process than girls at the same age, and most studies in Iran have been done on girls. Therefore, this study aimed to investigate the effect of education on the health belief model on preventive behaviors of T2D in male adolescents.

Materials and Methods

This quasi-experimental study was conducted with a pretest and posttest design in 2018, and 208 male high-school students participated in Hamadan, Iran. The students were selected using the stratified-proportional sampling method. The selection of samples was as follows; In the first phase, a list of secondary schools from both districts was prepared, then, by simple random method, eight schools were selected from boys' schools in high school (4 schools were from district one, and four schools were from district two). In each district, two schools were assigned to the control group and two schools to the intervention group. One hundred four students were placed in each control and intervention group. The control group schools were selected close to the intervention group schools. To be geographically and economically, socially, and culturally equal. In the second stage, in each school, relative stratified random sampling was selected from each middle school grade, and in the third stage, according to the number of required samples in a simple random method from each class, students were selected based on inclusion and exclusion criteria. To calculate the sample size based on a similar study [24], and the formula of:

$$n = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right)^2 \left(\sigma_1^2 + \sigma_2^2\right)}{(\mu_1 - \mu_2)^2}$$

With a 95% confidence interval, 80% power, and the common variance of perceived intensity in the two groups, and considering the probability of attrition, the minimum sample size required in each group was estimated, 104 people. Inclusion criteria include no history of participation in the formal training course on diabetes prevention, no diabetes, neuropsychiatric diseases, and other chronic diseases. Exclusion criteria included individuals' unwillingness to continue participating in the study, absence from training sessions for more than one session for any reason [23].

A 4-part questionnaire was used to collect data. A) Demographic information (14 questions); B) The awareness questionnaire consisted of 9 questions in 4-point Likert dimensions (3 incorrect options and one correct option). One point was given for each correct answer, and no score was given for the wrong answer/No answer. C) Questionnaire of health belief model constructs about preventive behaviors of T2Ds, which had a total of 48 questions in 6 dimensions: 1. Perceived sensitivity (7 questions), 2. Perceived severity (7 questions), 3. Perceived benefits (8 questions), 4. Perceived barriers (7 questions), 5. Perceived self-efficacy (9 questions) and 6. Cues to action (10 questions). The answers to the questions (perceived sensitivity, perceived severity, perceived benefits, perceived barriers, and cues to action on a 5-point Likert scale (strongly disagree, disagree, have no opinion, agree, and strongly agree). The answers to the perceived self-efficacy questions were on a 2-point Likert scale (Yes & No). The scores of perceived sensitivity (excluding question 7), perceived severity, perceived benefits, and cues to action were assigned to the strongly agree option (5) and the strongly disagree option (1). The negative question score was reversed. In the perceived self-efficacy dimension, the answer "Yes" was (2), and the answer "No" was assigned (1). D) A questionnaire to assess the preventive behavior of T2D, which included 11 questions related to nutrition, smoking, exercise, and exposure to stressful environments. The answers to the questions were in the form of a 2-point Likert scale (Yes & NO). To determine the questionnaire's validity, the initial questionnaire was first designed using the study of related books and articles, and then the instrument's content validity (CVR and CVI) was examined. For this purpose, a questionnaire was given to 10 experts in this field. Questions for which the amount of content validity was less than the desired amount were excluded from the test due to the number of experts evaluating the question. To determine the questionnaire's reliability, a pilot study was conducted with the participation of 10 students, and internal consistency was calculated using Cronbach's alpha method. For the dimensions of awareness and each of the dimensions: perceived sensitivity, perceived intensity, perceived benefits, perceived barriers, perceived self-efficacy, cues to action, and action, respectively 0.83, 0.84, 0.84, 0.88, 0.80, 0.92, 0.87, and 0.90. Cronbach's alpha value for the whole Health Belief Model Questionnaire was 0.86.

The necessary permission was obtained from the Hamadan Education Department; The researcher introduced himself to the students and explained the research's goals and methods; the students were also told that participation in the study was optional and that informed written consent was obtained the students' parents. In the next step, to conduct the pretest, questionnaires were distributed among the students, and they were asked to answer the questions in a calm environment. After the pretest, the subjects in the Intervention groups were trained according to the health belief model. The training course was held in one of the classes during three one-hour sessions, three weeks and once a week, in PowerPoint, lectures, and group discussions. After the posttest, the educational content was also provided to the control group to comply with ethical principles. In the first session, focusing on the nature of the disease and its complications, students were shown that they should feel the risk of developing diabetes (perceived sensitivity), then understand the possibility of developing diabetes and the seriousness of its various complications. In the second session, the emphasis was placed on diabetes prevention strategies such as nutrition and physical activity, the usefulness and applicability of diabetes prevention behaviors (perceived benefits), and how to remove barriers and implement T2D preventive behaviors (perceived barriers) was trained. In the third session, they were taught how to enable themselves to perform diabetes prevention behaviors (self-efficacy) and ultimately achieve proper performance on the prevention of T2D, and they were asked to implement a health promotion program in daily life. One month after the educational intervention, to conduct a posttest, the researcher went to the schools and redistributed the questionnaires among the students and asked them to complete the questionnaires.

Data were analyzed using SPSS software version 16, and mean±SD was calculated for quantitative data and qualitative data frequency. In the analytical statistics, the Chi-square test was used to investigate the relationship between qualitative variables, and Paired t-test, Independent t-test were used to investigate the relationship between quantitative variables. The significance level was considered 0.05.

Findings

All 208 students were examined. There was a significant difference between the two groups in terms of family smoking history (p<0.05), but there was no significant difference between the two groups in terms of other demographic variables (p<0.05; Tables 1 and 2).

Table 1) Mean±SD of demographic characteristics of the students in two groups based on Independent t-test

Variables	Control	Experimental	t	p-value
Age (year)	13.35±0.63	13.22±1.40	-2.15	0.63
Height (cm)	16.31±9.80	16.20±16.10	-0.60	0.55
Weight (kg)	51.49±13.35	50.00±13.00	-1.10	0.30
BMI (kg/m²)	19.64±4.24	19.16±4.40	-0.81	0.42

Table 2) Frequency of demographic characteristics of students in two groups; the numbers in parentheses are percentages

Variables	Control	Experimental	X^2	p.
Course of study				
Seventh grade	25 (24)	31 (30)		
Eighth grade	50 (48)	46 (44)	38.02	0.47
Ninth grade	29 (28)	27 (26)		
Education district				
Area 1	55 (53)	55 (53)	0.00	1.00
Area 2	49 (47)	49 (47)		
Father's education				
Illiterate	3 (2.9)	4 (3.9)		
Literacy, reading, and writing	21 (20.2)	14 (13.4)		
Under Diploma	32 (30.8)	33 (30.7)	6.39	0.49
Diploma	20 (19.2)	28 (26.9)		
Bachelor graduate	14 (13.5)	10 (9.7)		
Postgraduate	10 (9.6)	9 (8.7)		
PhD	4 (3.8)	6 (6.7)		
Number of family members				
2	1 (1)	2 (2)		
3	13 (13)	23 (22)		
4	50 (48)	47 (45)	5.21	0.27
5	36 (35)	26 (25)		
6<	4 (4)	6 (6)		
Father's occupation				
Employee	28 (27)	25 (24)		
Teacher	7 (7)	3 (3)		
Farmer	2 (2)	1 (1)		
Manual worker	8 (7)	3 (3)	5.69	0.46
Free	43 (41.5)	52 (50)		
Unemployed	1 (1)	1 (1)		
Other	15 (14.5)	19 (18.5)		
Mother's occupation				
Housewife	90 (86.5)	81 (77.9)		
Employee	7 (6.7)	12 (11.5)	0.13	0.13
Other	7 (6.7)	11 (10.6)		
Family history of T1D				
Yes	1 (1)	4 (3.8)	1.84	0.37
No	103 (99)	100 (96)		
Family history of T2D				
Yes	2 (1.9)	7 (6.7)	2.90	0.17
No	102 (98)	97 (93.3)		
Family history of smoking				
Yes	26 (25)	11 (10.6)	7.39	0.01
No	78 (75)	93 (89.5)		
Fast food consumption history in the past week				
Yes	64 (61.5)	68 (65.5)	0.08	0.89
No	40 (38.5)	38 (36.5)		

p-value was based on Chi²/Fishers exact test

Based on the statistical findings before training, the mean±SD of knowledge scores, perceived self-efficacy, and the control group's performance were significantly higher than the experimental group (p<0.001). However, there was no significant difference between the mean±SD scores of perceived sensitivity, perceived severity, perceived benefits, and perceived barriers to preventive behaviors of diabetes type 2 in the two groups (p<0.05). The educational intervention significantly increased the score of awareness, perceived sensitivity, perceived severity, perceived benefits, perceived barriers, perceived self-efficacy, cues to action, and preventive behaviors of diabetes type 2 in the experimental group (p<0.05), But there was no significant change in these variables in the control group (Table 3).

Table 3) Comparison of awareness, health belief model constructs, and students' preventive behaviors before and after training in two groups (Mean±SD)

Variables		Before training	After training	Paired t-test t.	Paired t-test p.
Awareness					
Experimental		3.77±1.99	6.64±1.42	-11.05	0.000
Control		5.18±1.82	5.38±2.13	-1.07	0.290
Independent t-test	t.	-5.37	4.99	-	-
	p.	0.00	0.00		
Perceived sensitivity					
Experimental		22.94±6.35	25.83±5.37	-3.88	0.000
Control		24.01±4.89	23.74±5.28	0.639	0.524
Independent t-test	t.	-1.36	2.83	-	-
	p.	0.17	0.00		
Perceived severity					
Experimental		23.43±5.82	25.09±6.37	-2.23	0.028
Control		23.57±4.99	23.13±5.10	0.781	0.436
Independent t-test	t.	-0.19	2.45	-	-
	p.	0.85	0.02		
Perceived benefits					
Experimental		31.39±6.85	33.33±5.70	-2.34	0.021
Control		30.54±6.92	30.37±7.25	0.278	0.781
Independent t-test	t.	0.89	3.27	-	-
	p.	0.38	0.00		
Perceived barriers					
Experimental		25.60±5.81	28.17±4.77	-4.33	0.000
Control		26.31±4.96	25.81±5.37	0.818	0.415
Independent t-test	t.	-0.95	3.34	-	-
	p.	0.34	0.00		
Perceived self-efficacy					
Experimental		16.10±1.94	16.59±1.39	-2.08	0.040
Control		16.53±1.88	16.48±1.71	0.677	0.500
Independent t-test	t.	-2.09	0.270	-	-
	p.	0.04	0.79		
Cues to action					
Experimental		32.10±8.83	34.80±8.68	-2.35	0.021
Control		33.72±8.87	33.34±8.68	0.484	0.629
Independent t-test	t.	-1.26	1.21	-	-
	p.	0.21	0.23		
Preventive behaviors					
Experimental		16.10±1.94	16.53±1.88	-4.60	0.000
Control		16.59±1.39	16.47±1.70	1.46	0.147
Independent t-test	t.	-4.22	0.707	-	-
	p.	0.00	0.48		

After training, the mean±SD scores of awareness, perceived sensitivity, perceived severity, perceived benefits, and perceived barriers in the experimental group were significantly higher than the control group (p<0.01), but there was no significant

difference among the mean±SD scores of perceived self-efficacy, cues to action in the two groups ($p<0.05$; Table 3).

The results of linear regression showed that the perceived self-efficacy (β=0.174; T=2.48) was the most effective variable in determining the preventive behavior of T2D, which significantly predicts the preventive behavior of T2D ($p<0.05$; Table 4).

Table 4) Linear regression analysis for predicting preventive behaviors of Diabetes Type 2

Independent variables	B	SE	β	T	p-value
Constant	11.2	1.90	-	5.77	0.00
Awareness	-0.13	0.09	-0.09	-1.33	0.18
Perceived sensitivity	0.05	0.04	0.11	1.40	0.16
Perceived severity	-0.03	0.03	0.06	-0.87	0.38
Perceived benefits	0.03	0.03	0.08	1.10	0.27
Perceived barriers	0.05	0.04	0.10	1.47	0.15
Perceived self-efficacy	0.25	0.10	0.17	2.48	0.01
Cues to action	0.03	0.02	0.12	1.68	0.09

Dependent variable: Preventive behaviors of diabetes type 2

Discussion

This study aimed to investigate the effect of education based on the health belief model on preventive behaviors of T2D in male adolescences in Hamadan. The results indicated that the students' awareness, perceived susceptibility, perceived severity, perceived benefits, perceived self-efficacy, and preventive behaviors of Diabetes Type 2 were promoted following the implementation of HBM-based education. Furthermore, the perceived barriers to the preventive behaviors of Diabetes Type 2 decreased among the students following HBM-based education.

One of the findings in this study suggested that the student's awareness was promoted after implementing the health education intervention, which was based on HBM. For example, they knew more about the nature of T2D and the risk factors of the disease. Given that improving disease awareness can enable individuals to understand DM [25] better, it should be considered a key component in education. In this regard, Komolafe *et al.* believe that education is an effective tool for creating awareness and strengthening behavioral changes in adolescents' health and disease conditions [26]. The results of the present study are also consistent with the study of Holder & Ehehalt [18], Khodaveisi *et al.*, [27], and Fadaei *et al.* [28].

Another finding of this study showed that perceived sensitivity and severity increased after HBM-based education; accordingly, after health education intervention, the students saw themselves more vulnerable to probable effects of T2D (perceived sensitivity), or they realized that without disease risk factors reduction, probable irreversible effects of T2D would increase in the future (perceived severity). It has shown that the more sensitive a person is to the risk of affection the disease, the more aware they will be of the risk of developing the disease [29]. These findings are supported by previous studies in Iran in which an educational intervention based on HBM improved students' perceived susceptibility to unhealthy behaviors [30]. It is also documented that secondary school adolescents' dietary habits in Egypt are partly related to perceived severity [31]. In contrast, similar interventional studies revealed that perceived sensitivity [32] and perceived severity [33] were not changed in HBM-based education in Iranian school students. This discrepancy may be related to the student's perception of the nature of the disease or the different methodology.

In the present study, the students also became more aware of disease prevention benefits; in this regard, they believed that risk factor reduction such as healthier nutrition and regular physical activity would prevent T2D in the future. Perceived benefits are related to believing in the benefits of the proposed methods to reduce the risk or harmful state of a particular behavior. This educational intervention could identify the positive benefits of adopting diabetes-preventing behaviors. The present study's findings are consistent with the study of Wisanti *et al.* [34] and Liese *et al.* [35]. In other words, taking action to prevent the disease or its complications depends on understanding its benefits [36]. Health education experts also believe that a person's understanding of behavior's benefits can facilitate behavior change. The more benefits are felt due to the behavior, the greater the effort to engage in that behavior [37].

In this study, the mean±SD scores of perceived barriers on preventive behaviors of T2D decreased in students after HBM-based education. For example, they identified fewer barriers to improving nutrition behaviors and exercising than before. One of the purposes of health education intervention based on HBM is to lower perceived barriers. In this regard, it has been shown in some studies that if individuals perceive benefits rather than barriers, they will involve in that healthy behavior. The perceived barrier is a person's belief in action's physical and mental costs [38]. The present study was consistent with an Iranian study in which students' perceived barriers about AIDS preventive beliefs were reduced [39]; however, it could not be affected in another interventional HBM-based education [40]. This difference may be due to the significant variety of perceived barriers, including material, psychological, and social barriers. In this regard, Kristensen *et al.* also believe that if a teenager develops diabetes, he/she will face many obstacles. Barriers such as adherence to treatment, the complexity of a treatment regimen, acceptance of peers, and increased responsibility will prevent adolescents from adhering to their treatment regimens [38]. Heeseman also believes that after understanding the barriers, it is necessary to reduce

any barriers to adolescents to prevent and even manage diabetes to improve the quality of life now and in the future [13].

In the present study, the educational model's implementation had an increasing effect on the perceived self-efficacy of preventive behaviors of T2D in the students; in a way, they felt more confident of reducing T2D risk factors by following the HBM-based education. Self-efficacy is defined as an individual's belief and confidence in his/her abilities to perform a behavior successfully and is a vital and influential construct emphasized in educational theories [41, 42]. It has shown that people with high self-efficacy remove obstacles by improving self-management and perseverance skills and experience less uncertainty [43]. In similar studies, perceived self-efficacy was one of the basic constructs for modifying behavior [44, 45].

Based on the present study's findings, the mean±SD score of the cues to action in the intervention group increased. In this study, the mass media, teacher's education, was considered the most significant cues to action by the students before the intervention; however, after education, the students expressed that HBM-based education was useful for the guidance. 'Cues to action' are considered as external stimuli to adopt the disease prevention behavior [46].

This study's last finding showed that HBM-based education affected the student's preventive behaviors of Diabetes Type 2. For example, they ate at least five servings of fruits and vegetables, one serving of fish in their diet in a week. They also had consumed healthy snacks at school in a week, and they also exercised for 30 minutes or more on most days of the week. Hence, it can be concluded that HBM-based education is an appropriate strategy for improving the student's preventive behaviors of T2D. The previous studies in Iran also suggested that the health education intervention based on HBM is an adequate and comprehensive model that affects adolescent's adherence to disease prevention [28, 33, 39, 47, 48].

After entering the variables in the linear regression analysis model, multivariate analysis showed that the perceived self-efficacy variable could be used to predict behavioral prevention T2D in students. It could be concluded that self-efficacy is the most important construct in adolescents and had the highest correlation with T2D preventive behaviors. Similar studies also showed that self-efficacy is the strongest construct in predicting behavior change and an important precondition for self-management to change behavior and promote healthy behavior [49, 50, 51].

One of the limitations of the present study is the self-report nature of the questionnaires and the impossibility of directly observing students' behaviors. Another limitation of the study was the possibility of receiving information related to diabetes prevention by the students during the study. Therefore, we selected two groups (intervention and control groups).

Conclusion

According to the results of this study and previous studies in this field, it seems that the health belief model can be used as a suitable framework for improving health-promoting behaviors in male adolescents. Therefore, due to the importance of adolescence, it is suggested that this model be used in teaching preventive behaviors of other chronic diseases with high prevalence and for students of non-governmental and rural schools and other high-risk groups in adolescents Because health habits and patterns are formed in childhood and adolescence. At this age, proper health behaviors are also effective on health and well-being in the coming years. It is necessary to include educational programs in health promotion and diabetes prevention in school health programs.

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