Effect of Applying Health Belief Model on Type 2 Diabetic Patients' Knowledge, Self-Care Practices and Health Beliefs

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Abstract

Background: Effective management of type 2 diabetes poses a significant public, medical and behavioral health challenge, predominantly with the high prevalence attributable to unhealthy lifestyle behaviors. **Aim:** This study aimed to assess the effect of applying a health belief model (HBM) on type 2 diabetic patients' knowledge, self-care practices, and health beliefs. **Research Design:** A quasi-experimental pre and post-test, one-group only design was utilized for this study. **Setting:** This study was carried out at the diabetic outpatient clinics affiliated with the Medical Specialized Hospitals/Mansoura University, Dakahlia Governorate, Egypt. **Subjects:** A convenient sample of 72 type 2 diabetic patients who agreed to participate in the study was utilized. **Tools of data collection:** Four structured interview sheets were designed, namely (socio-demographic, knowledge, self-care practices, and health beliefs). **The results:** The study results revealed highly statistically significant differences with an improvement in total patients' knowledge and self-care practices' score in post-educational intervention based on HBM as compared with pre-intervention. Additionally, post-intervention, the mean score of each HBM constructs: susceptibility, severity, benefits, cues to action, and self-efficacy were increased significantly (except the barriers construct which was declined) compared to pre-intervention (P-value <0.000). **Conclusion:** The application of the HBM model was proved to be effective in increasing knowledge, promoting the self-care practices and health beliefs of patients with type 2 diabetes mellitus. **Recommendations:** Increasing people's awareness of their disease, treatment adherence, adopting a healthy lifestyle via education and training classes should be emphasized. Beside, supporting, continuous, and well-designed training programs for healthcare professionals should be established to apply HBM on chronic disease prevention and control.

Keywords: Health Belief Model (HBM), Knowledge, Type 2 Diabetes Mellitus, Self-Care Practices.

Introduction

Diabetes mellitus (DM) is one of the major public health problems with a significant chronic medical, social and financial impact and has come to be considered a global health emergency of the 21st century. Globally, the International Diabetes Federation estimated that 463 million adults are

currently affected by this condition, with an anticipated increase of 700 million by 2045 (International Diabetes Federation, 2019). In addition to, 1.6 million deaths are directly attributed to diabetes annually (World Health Organization, 2021). Egypt was recorded as the ninth leading country in the world for the number of patients with type 2 diabetes by the IDF. Over the previous two decades, the prevalence in Egypt nearly tripled (Hegazi, El-Gamal, Abdel-Hady & Hamdy, 2016). It is around 15.6% among adults between 20 and 79 years old. It is anticipated that the number will jump up to 13.1 million by 2035, with a yearly death of 86,478 related to diabetes (International Diabetes Federation's IDF, 2015). This marked rise could be attributed to obesity, physical inactivity, eating pattern changes, increased exposure to environmental risk factors like pesticides, and elevated prevalence of chronic hepatitis C (Hegazi, El-Gamal, Abdel-Hady & Hamdy, 2016).

The disease necessitates persistent high-cost treatment with multi-factorial risk reduction strategies outside glycemic control (American Diabetes Association, 2021) & (Grant & Cosentino, 2019). Constant self-management education and support presented to patients are elementary for avoiding acute complications, reducing the risk of long-lasting complications and maintaining a healthier quality of life for patients. In consequence, the American Diabetes Association announced that every diabetic patient ought to be a participant in a diabetes self-management educational (DSME) program (Mikhael et al., 2018).

As a part of self-care management, health-related behaviors are determined by health and illness beliefs based on a person's knowledge of the disease. Properly speaking, construct of the belief can improve health and well-being, and consequent lessening costs in all aspects of health care (Khosravizadeh et al., 2020). As a result, the health belief model (HBM) is one of the most widely used notions in theoretical studies in behavior change and knowledge (Antwi et al., 2020).

The health belief model gives ways to have the knowledge of the attitude, health-related behaviors, and peoples' educational needs and therefore, can be used as an applied tool to form impressive public health intervention strategies (Kloeblen, 1999). The model declared that once a person believes he or she is vulnerable to a medical problem with serious consequences, the person would most likely conclude that the benefits exceed the barriers coupled with altering one's behavior to avoid the problem (Raingruber, 2017). The researchers are empowered by the model to clarify and anticipate health-promoting behavior with relation to beliefs' patterns by addressing the association regarding health behaviors and utilization of health services (Jose et al., 2021). This model comprises six basic constructs containing perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (Hazavehei et al., 2007 & National Cancer Institute, U.S. Department of Health and Human Services, et al., 2012). The HBM designed for nurses is an extraordinary instrument, providing them with a theoretical framework aimed at supporting their patients prevent chronic disease or, in case that the disease is exists, enhance quality of life (Tanner-Smith & Brown, 2010).

To our knowledge, few studies on the effects of HBM-based educational intervention on diabetic patients were conducted (Hazavehei et al., 2007). Several policies for early diagnosis and control of diabetes mellitus have been developed in various nations so far. Unfortunately, some of them have overlooked the role of patient knowledge and behavior (Khosravizadeh et al., 2021). To deal with this gap and thinking around the above issues with the significance of health education in controlling type 2 diabetes mellitus, the researchers used this model with relevance to type 2 diabetes mellitus for the crucial hypothesis of the model. In particular, self-care practices increase as a task of the patients' perceptions of greater susceptibility to the illness, more prominent disease severity, as well as associated complications, more perceived benefits of self-care, the fewer perceived barriers to self-care, more social cues to self-care, and greater self-efficacy to self-care.

Aim of the study

Assessment of the effect of applying HBM on type 2 diabetic patients' knowledge, self-care practices, and health beliefs.

Study hypothesis

Application of HBM will improve diabetic patients' knowledge, self-care practices, and health beliefs and in this way will control type 2 diabetes mellitus.

Subjects and Methods

Study design:

A quasi-experimental, one-group, pre-posttest research design was used in this study. This type of design is an empirical study used to estimate the effect of an intervention in its target population without random assignment (Pattison, Gutwill, Auster & Cannady, 2019).

Study setting:

This study was conducted at the diabetic outpatient clinics of the Medical Specialized Hospitals/Mansoura University, Dakahlia Governorate, Egypt throughout the period from December 2020 to July 2021. The clinics are responsible for providing diagnostic, treatment, and follow-up care of diabetic patients.

Sampling technique and size:

A purposive sampling technique was employed to recruit participants in this study. The sample size was calculated using Medcalc 15.8 (https://www.medcalc.org/). The primary outcomes of interest are improvement of type 2 DM-related knowledge, self-care practices, and health beliefs. With an alpha error of 5%, study power of 80%, and 5% precision, then the sample size was 72 patients.

Participants, inclusion, and exclusion criteria:

The study participants were adult patients aged 35-55 years, both sexes, with at least one year of diagnosis of type 2 diabetes mellitus firmly established by a specialist. As well as who attended the outpatient clinics on customary follow-up for at least three visits and were willing to be involved in the study. Patients with type 1 diabetes, gestational diabetes, a

history of psychological disorders such as mood or anxiety disorders that prevent them from receiving the intervention, and patients who were unable or unwilling to participate in the study were all excluded. These participants were excluded since coexisting disease could probably influence their health beliefs, the primary variable in this study.

Outcome measures:

Primary outcome measures:

Improved of type 2 DM-related knowledge, self-care practices, and health beliefs.

Secondary outcome measures:

Achievement of glycemic control.

Tools of Data Collection

The data collection tools were designed by the researchers after reviewing the preceding relevant studies (Effiong, 2020 & Heidari et al., 2016 & Vahidi et al., 2015 & Baghiani Moghadam M. et al., 2014). Four structured tools were utilized in this study through face-to-face interviews, pre and post the application of HBM.

Tool (I): Socio-demographic and patients' medical health assessment interview sheet that included two parts: -

Part (1): Socio-demographic interview sheet was used to extract data such as age, sex, marital status, background education, occupation, residency, and monthly income.

Part (2): Patients' medical health assessment interview sheet that included essential current and previous medical health history, disease duration, symptoms, and current intake of hypoglycemic medications. Moreover, weight, height, body mass index (BMI), and fasting blood glucose were also obtained.

Tool (2): Patients' knowledge interview concerning type 2 diabetes mellitus was used to assess patients' knowledge pre and post application of the HBM educational intervention. The tool was a multiple-choice MCQ form that was classified into eight parts and made out of 88 questions. One mark was allocated for each right response. The strategy for counting the scores was the frequency each answer was chosen. The mean score was likewise calculated. Knowledge scores were converted to indicate the percentage. The knowledge score level was sorted into three levels as poor= scores under 50% of total scores (0- less than 44 marks); fair= scores 50% to 65% of total scores (44- less than 57.2 marks), and good= scores over 65% of total scores (more than 57.2 marks) according to the researchers' cutoff point.

Tool (3): Patients' self-care reported practices interview sheet regarding type 2 diabetes mellitus was used to assess the following domains of the patients' self-care practices in the last seven days: diet (3 items), exercise (1 item), smoking cessation (1 item), foot care (3 items), medication regimen (2 items), blood glucose testing (1 item), follow-up (1 item). One mark was allocated for each item. The total scores were computed for each domain by summing the item scores (possible range 0–12 marks). Self-care practice scores were converted to indicate the percentage. The self-care practices score

level was sorted into two levels: satisfactory (scores 65% of total scores and more) and unsatisfactory (scores less than 65% of total scores) according to the researchers' cutoff point.

Tool (4): Patients' health beliefs interview sheet regarding type 2 diabetes mellitus was used to explore patients' health beliefs toward type 2 diabetes mellitus with six constructs (28 statements). It included perceived susceptibility (3 items), perceived severity (5 items), perceived benefits (3 items), perceived barriers (5 items), cues to action (5 items), and self-efficacy (7 items).

The scoring system of HBM: Interpretation of answers was classified into three levels: agree, neutral, and disagree. The two marks were awarded to agree, one mark to neutral, and zero for disagree. If the statement was negative, the scoring system in SPSS was reversed; zero was allocated to agree, one mark to neutral, and two marks to disagreeing. Each construct was calculated distinctly, and therefore six different scores were obtained for each patient. The mean scores of the construct were obtained by summing. The possible total score range was (28-56 marks), and a higher score indicated a more positive health belief toward type 2 diabetes mellitus. Two points were given for agreeing, one point for neutral, and zero for disagreeing. If the statement was negative, the scoring system in SPSS was reversed: zero points for agreeing, one point for neutral, and two points for disagreeing.

Methods

Preliminary Stage:- Prior to conducting the study, formal consent from the faculty of nursing was produced to the appropriate authorities in the chosen setting. After clarifying the aim of the study, an endorsement to conduct the study was obtained to gain their collaboration and support during data collection.

Literature Review: An audit of previous, recent, local and international literature was completed on the numerous aspects of type 2 diabetes mellitus employing scientific published articles and web search.

Study Tools Development: Following a review of the validated related literature, tools of the current study were designed by the researchers in a simple Arabic language and keeping with the study theoretical framework using the health belief model.

Validity & Reliability of the Tools: The tools were presented to a board of six experts in "community health nursing, statistics, and health education" for face and content validity assessment. Their recommended alterations had been finished. The designed interview sheets were tested for their reliability utilizing the test-retest method which was completed about 10% of patients (8 patients) who met the inclusion criteria and were demographically like those joining the study and who were not in the sample group.

The following week, the interview sheets were performed again, and the results were as follows: - The reliability for the knowledge and self-care practice sheets was (0.83 and 0.78) correspondingly. The Cronbach's alpha coefficient test for the health belief scale was 0.77 (0.70 for perceived

susceptibility, 0.71 for perceived seriousness, 0.82 for perceived benefits, 0.81 for perceived barriers, 0.83 for recommended health behavior, and 0.78 for cues to action). These results confirmed that this scale was internally consistent.

The patients were carefully chosen from the same setting in order to assess the study tool's accuracy, completeness, and applicability, as well as the time of completion, and identify any hurdles or problems that might hinder data collection and possible solutions. Based on the collected information, the required modifications were implemented, few questions were added, and others were clarified or deleted.

Operational Stage: -The head of the department and the patients were informed about the aim of the study at the selected setting to gain their cooperation. The designed data collection tools allowed the researchers to ask the same questions to all patients. Data were collected through two stages pre- and post-intervention. Patients were face-to-face interviewed using standardized interview sheets in the pre-intervention stage for exploration of their knowledge, self-care practices, and health beliefs concerning type 2 diabetes mellitus by using (tools 2, 3, and 4). Each patient consumed from 20-25 minutes, about 5-7 sheets were filled\day.

Anthropometric measurements were performed as height was measured by a wall-mounted stadiometer to the nearest 0.1 cm. On the same appropriately calibrated electronic digital scale, without shoes, with minimum clothing, and after voiding, weight was determined to the closest 0.1kg. Furthermore, the body mass index (BMI) was computed by dividing the weight in kilograms (kg) by the height in square meters. (m^2) and BMI 30 was considered as obese (Centre for Disease Control, 2021). Investigation of glycemic control was done through the determination of fasting blood glucose with 12 hours fasting since the last meal or snack. A qualified nurse appointed from the hospital took a venous blood sample (3 ml) from every patient. The samples were directly transferred to the laboratory. On the same day, an analysis was performed. Patients were sufficiently informed about the purpose.

For precision, data cleaning and cross-checking were done on a daily basis by the researchers. The researchers tried to build trusting relationships with the patients and attempted to understand the various issues facing them at home through the communication process. Afterward, the results were analyzed to structure the educational intervention contents based on the health belief model and by following the principles of health education. The data collection was extended for two months.

Development of HBM Educational Intervention regarding Type 2 Diabetes Mellitus: The structured HBM educational intervention of the study was designed by the researchers and then reviewed by the experts in the department of community health nursing. It was offered by local and plain language for the promotion of awareness and health behaviors among type 2 diabetic patients. It was focused on raising their awareness about their susceptibility to diabetic complications, disease severity, and how to overcome the threats. This was done by improving their self-confidence in their ability to

control the disease. In the same way, increasing their positive health beliefs towards the benefits of controlling diabetes mellitus was also stressed. The health education information was obtained from (American Diabetes Association, 2021 & World Health Organization, 2021) and was approved by a panel of specialists. The constructs of HBM were used as a guide in each educational session provided to the patients (Supplement 1).

Application and Assessment of the HBM Educational Intervention: The researchers applied the structured HBM educational intervention to the patients through four face-to-face group sessions (45 to 60 minutes) for two months in the health education room at the selected clinic and at a convenient time. Each session had five to seven patients. Discussion and feedback were used for knowledge and videos for practice such as healthy diet, practicing exercises, foot care to prevent injury at the lower extremities. The patients were asked to demonstrate practically monitoring of blood glucose, and insulin self-injection. Each patient was provided with a clear picture-based educational flyer containing appropriate materials related to the definition of type 2 diabetes mellitus, prevalence and risk factors; symptoms, diagnosis, complications, treatment, and the benefits of adopting healthy behaviors (lifestyle modification, hypoglycemic drugs, and foot care) to prevent long-term complications of diabetes mellitus. This was implemented through patient-provider interactive communication and little numbers of teaching messages rather than general knowledge.

To enhance patients' family support in how to assist them control their diabetes, an educational flyer was provided to the accompanying family member(s). The assessment was applied by comparing knowledge, self-care practices, and health beliefs related to type 2 diabetes mellitus pre and post three months of HBM educational intervention application by using (tool 2, 3, and 4) with re-assessment of BMI and blood glucose. Only subjects who completed all the sessions were included in the results.

Statistical Analysis

Data were ordered, coded, sorted, and then transferred into specially designed formats. Analysis was done using a PC with Statistical Product and Service Solution (SPSS for windows program version 25; Armonk, NY: IBM Corp). Data were tested for normality of distribution before any calculations with the Kolmogorov-Smirnov test. To summarize descriptive statistics, frequencies, cross-tabulations, and tables were used for data presentation. For continuous variables, arithmetic mean and standard deviation were utilized. For categorical variables, the percentages were utilized. To compare the mean of scores of HBM constructs pre and post the intervention, the paired-samples t-test was used for comparison between and within groups and the significance of the results. Other associations were evaluated with Pearson's correlation coefficient. $P<0.05$ was viewed as statistically significant variables.

Ethical Consideration

Ethical permission was accessed from the institutional review board of the Faculty of Nursing, Mansoura University.

Before starting data collection and application of the intervention, the patients' written informed consents were taken after obtaining the detailed study information. Enrollment in the study did not disturb the patients' treatment process. The patient had the right to disengage from the study whenever without reason. Information was dealt with confidentially and anonymity in the study.

Results:

Table (1): Seventy-two type 2 diabetic patients with the mean age of 42.2±6.74 years were assessed, 55.6% were females, 27.7% were highly educated and 75% were living in urban areas as revealed in.

Figure (1): presented in Pre-application of HBM educational intervention revealed that 88.9% of the patients showed a poor score level of knowledge compared to 1.4% who showed a good score level of knowledge. However, post-intervention of HBM application, 93.1% of them showed a good score level of knowledge as.

Table (2): portrays that 5.6% of patients showed satisfactory total self-care practices score pre-intervention of HBM application compared to 87.5% post-intervention of HBM application related to dietary habit

s, exercise, smoking cessation, foot care, medication adherence, periodic blood glucose measurement, and diabetic follow-up.

Table (3): Patients' beliefs regarding susceptibility to diabetic complications revealed in the pre-application of the HBM educational intervention that 6.9% of the patients acknowledged that they are susceptible to diabetic complications compared to 87.5% post-application of the model. Furthermore, 4.2% of the patients recognized that diabetic complications are threatening and severe; however, post-application of the educational intervention it reached 79.2% of the patients. As regards the benefits from adherence to the advised healthy behaviors in the pre-application of the educational intervention, 2.8% of the patients agreed that diabetic control assisted them in improving their quality of life compared to 83.3% post-HBM application.

Concerning the barriers of adherence to the advised behaviors, 79.2% of patients admitted that the side effects of medications could stop achieving diabetic control in the pre-application of educational intervention compared to 13.9% post-HBM application. Likewise, 30.6% of patients agreed that the advice from the healthcare team made them adhere to healthy behaviors compared to 72.2% post-HBM application. Patients' beliefs regarding self-efficacy in the pre-application of the intervention showed that 13.9% of the patients agreed that they could control disease and adhere to follow-up schedules. However, 73.6% of the patients post-application of the educational intervention acknowledged the previously mentioned items as presented in.

Table (4): illustrated in a positive significant correlation between type 2 diabetic patients' knowledge, self-care practices, and health beliefs post-

application of health belief model constructs were illustrated in (Table 4).

Table (5): Post-application of HBM educational intervention, a significant increase (t= -14.9, P=.000) by 109.5% in perceived susceptibility value among type 2 diabetic patients was observed with a mean of 4.84±0.85 compared with a mean of 2.31±1.25 pre-application of the HBM intervention. With respect to perceived severity, post HBM intervention application, a significant increase by 54.5% (t=-10.5, P=.000) was observed with a mean of 6.80±1.63 compared with a mean of 4.40±1.82 pre intervention of HBM. Regarding perceived benefits post HBM application, a significant increase (t= -19.2, P=.000) by 108.7% was observed with a mean of 5.30±1.01 compared with a mean of 2.45±0.88 pre-intervention.

Concerning perceived barriers post-HBM application, a significant decrease (t= -24, P=.000) by -48.6% was observed with a mean of 4.68±1.53 compared with a mean of 9.11±0.88 pre-intervention. With respect to cues to action post-application of HBM, a significant increase (t= -14, P=.000) by 62.5% was observed with a mean of 8.45±1.14 compared with a mean of 5.20±1.60 pre-intervention. As regards self-efficacy post-application of HBM, a significant increase (t= -13, P=.000) by 52.7% was observed with a mean of 11.7±1.66 compared with a mean of 7.66±1.98 pre-intervention. Concerning to total constructs of the health belief model post-application of educational intervention, a significant increase (t= -26.3, P=.000) by 72.4% in total constructs value among type 2 diabetic patients was observed with a mean of 46.2±3.93 compared with a mean of 26.8±5.26 pre-HBM intervention as depicted in.

Table (6): shows that there were statistically significant differences between type 2 diabetic patients' knowledge score, self-care practices score, BMI, and blood glucose level pre and post-application of health belief model.

Table (1): Distribution of type 2 diabetic patients according to their socio-demographic characteristics and health history (n=72).

Variables	N	%
Age/years	**±S.D**: (42.2±6.74) years	
30-less than 40 years	28	38.9
40 years and above	44	61.1
Sex		
Male	32	44.4
Female	40	55.6
Marital status		
Married	54	75
Unmarried	18	24.9
Level of education		
Illiterate/ Read and write	28	38.9
Primary	4	5.6
Preparatory	4	5.6
Secondary	16	22.2
Higher education	20	27.7
Residence		
Rural	18	25
Urban	54	75
Duration of diagnosis		
Less 5 years	44	61.1
From 5 to 10 years	15	20.8
More 10 years	13	18.1
History of hypoglycemia	29	40.3
History of hyperglycemia	47	65.3
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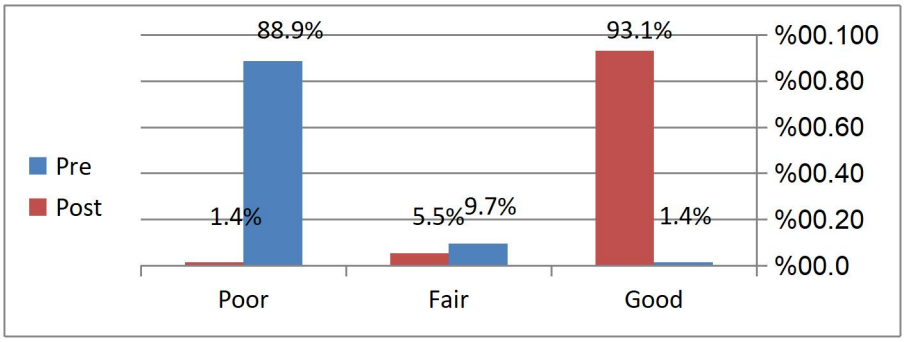

Figure (1): Distribution of Type 2 Diabetic Patients' Knowledge regarding their Disease Pre- and Post-Application of HBM Educational Intervention (n=72).

Good= more than 65% of total scores. **Fair**= 50% to 65% of total sores. **Poor**= less than 50% of total scores.

Table (2): Distribution of Type 2 Diabetic Patients' Reported Self-care Practices regarding their Disease Pre and Post-Application of HBM Educational Intervention (n=72).

Self-care Practices' Variables	Pre		Post		Significance	*P* value*
	N	%	N	%		
Dietary intake						
Following a diabetic diet regimen	23	31.9	51	70.8	χ^2 =21.7	.000
Number of meals per day						
From 1 to 3 times	62	86.1	9	12.5	χ^2 =78	.000
From 4 to 6 times	10	13.9	63	87.5		
Type of meals						
Ordinary diet	54	75	3	4.2		
Low carbohydrates diet	3	4.2	17	23.6	Monte Carlo test [a]	.000
Healthy and balanced diet	15	20.8	52	72.2		
Practicing physical exercise for at least 5 days in a week for 20–30 min						
Following an exercise program	12	16.7	43	59.7	χ^2 =28.2	.000
Duration of exercise/week						
Less than 2.5 hours/week	66	91.7	29	40.3		
2.5 hours- 4 hours/week	5	6.9	33	45.8	χ^2 =42.4	.000
More than 2.5 hours/week	1	1.4	10	13.9		
Smoking habits						
Smoking cessation	11	15.3	10	13.9	χ^2 =.056	.500
Foot care						
Checking the foot daily	24	33.3	59	81.9	χ^2 =34.8	.000
Daily foot care	26	36.1	58	80.6	χ^2 =29.2	.000
Nail care	27	37.5	64	88.9	χ^2 =40.8	.000
Adherence to a medication regimen						
Drug taking in the prescribed dose	43	59.7	65	90.3	χ^2 =17.9	.000
Drug taking in the prescribed time	46	63.9	68	94.4	Monte Carlo test [a]	.000
Blood glucose measurement						
Periodic blood glucose measurement	22	30.6	63	87.5	χ^2 =48.2	.000
Adherence to follow-up schedule						
Periodic follow-up	33	45.8	65	90.3	χ^2 =32.7	.000
Total self-care practices level (12 marks)						
Satisfactory	4	5.6	63	87.5	χ^2 =97.1	.000
Unsatisfactory	68	94.4	9	12.5		

a: 2 cells have expected cell count <5 χ^2:Chi-square test.

Table (3): Distribution of Type 2 Diabetic Patients' Beliefs regarding their Disease Pre and Post-Application of HBM Educational Intervention (n=72).

HBM constructs	Pre						Post					
	Agree		Neutral		Disagree		Agree		Neutral		Disagree	
	N	%	N	%	N	%	N	%	N	%	N	%
Type 2 diabetic patients' beliefs regarding the susceptibility to diabetic complications												
People with type 2 DM have a susceptibility to develop diabetic complications	33	45.8	20	27.8	19	26.4	67	93.1	3	4.2	2	2.8
Females are more susceptible to diabetic complications than male	28	38.9	39	54.2	5	6.9	42	58.3	12	16.7	18	25
I am susceptible to develop diabetic complications	5	6.9	33	45.8	34	47.2	63	87.5	0	0	9	12.5
Type 2 diabetic patients' beliefs regarding the severity of type 2 diabetes mellitus												
Complications of diabetes mellitus are threatening and sever	3	4.2	20	27.8	49	68.1	57	79.2	3	4.2	12	16.7
Diabetes mellitus can be controlled	34	47.2	31	43.1	7	9.7	56	77.8	10	13.9	6	8.3
Diabetes mellitus can lead to death	27	37.5	30	41.7	15	20.8	21	29.2	20	27.8	31	43.1
Consequences from non-adherence to treatment are very dangerous	24	33.3	25	34.7	23	31.9	55	76.4	9	12.5	8	11.1
There is no negative effect on my marital life	26	36.1	16	22.2	30	41.7	27	37.5	11	15.3	34	47.2
Type 2 diabetic patients' beliefs regarding the benefits from adherence to the advised healthy behaviors related to type 2 diabetes mellitus												
The adherence to the treatment regimen can reduce complications	13	18.1	11	15.3	48	66.7	66	91.7	5	6.9	1	1.4
Diabetic control help in improving quality of life	2	2.8	21	29.2	49	68.1	60	83.3	6	8.3	6	8.3
Periodic follow-up can reduce diabetic complications	3	4.2	19	26.4	50	69.4	58	80.6	7	9.7	7	9.7
Type 2 diabetic patients' beliefs regarding the barriers of adherence to the advised behaviors related to type 2 diabetes mellitus												
Life stressors and problems can hamper periodic follow-up	55	76.4	14	19.4	3	4.2	6	8.3	1	1.4	65	90.3
Medication taking hinder me from the activity of daily life	39	54.2	17	23.6	16	22.2	11	15.3	1	1.4	60	83.3
Expensive medications and limited income prevent diabetic control	49	68.1	14	19.4	9	12.5	15	20.8	2	2.8	55	76.4

Side effects of medications can stop diabetic control	57	79.2	9	12.5	6	8.3	10	13.9	1	1.4	61	84.7
Diabetes mellitus hinder me from social activities/visits	51	70.8	12	16.7	9	12.5	10	13.9	1	1.4	61	84.7
Type 2 diabetic patients' beliefs regarding cues to action related to type 2 diabetes mellitus												
Diabetic symptoms' severity led me to seek medical help	10	13.9	6	8.3	56	77.8	60	83.3	1	1.4	11	15.3
The healthcare team' advice make me adhere to healthy behavior	22	30.6	13	18.1	37	51.4	52	72.2	2	2.8	18	25
Relative support increases my desire to adhere to healthy behavior	21	29.2	15	20.8	36	50	50	69.4	3	4.2	19	26.4
A member of my family help me to take diabetic medications	9	12.5	16	22.2	47	65.3	46	63.9	0	0	26	36.1
A member of my family motivate me to consume a healthy diet and exercise	18	25	15	20.8	39	54.2	47	65.3	0	0	25	34.7
Type 2 diabetic patients' beliefs regarding self-efficacy related to type 2 diabetes mellitus												
I do my best for controlling disease and preventing its' complications	16	22.2	19	26.4	37	51.4	47	65.3	2	2.8	23	31.9
I do not feel anxious about diabetes mellitus	34	47.2	9	12.5	29	40.3	51	70.8	0	0	21	29.2
I can control disease and adhere to the treatment regimen	19	26.4	12	16.7	41	56.9	53	73.6	1	1.4	18	25
I can control disease and adhere to a diabetic diet regimen	15	20.8	13	18.1	44	61.1	51	70.8	0	0	21	29.2
I can control disease and adhere to exercise for weight control	16	22.2	9	12.5	47	65.3	40	55.6	4	5.6	28	38.9
I can control disease and adhere to follow up schedule	10	13.9	16	22.2	46	63.9	53	73.6	0	0	19	26.4
The disease management decision should be done by the patient	10	13.9	16	22.2	46	63.9	53	73.6	0	0	19	26.4

Table (4): Correlation between Type 2 Diabetic Patients' knowledge, Self-Care Practices and Health Beliefs Post-Application of Health Belief Model (n=72).

Variables	Health Beliefs Construct Score	
	r	*P* value
Self-care practices score	.412	.068
Knowledge Score	.318	.006

r: for Pearson correlation P value significant if ≤ 0.05 If r≤0.5= weak correlation If r>0.5= strong correlation

Table (5): Mean Differences of Type 2 Diabetic Patients' Beliefs regarding their Disease Pre and Post-Application of HBM Educational Intervention (n=72).

HBM domains	Pre-intervention ±S.D	Post-intervention ±S.D	% of change	t- value	*P* value
Perceived susceptibility	2.31±1.25	4.84±0.85	109.5	-14.9	0.000
Perceived severity	4.40±1.82	6.80±1.63	54.5	-10.5	0.000
Perceived benefits	2.54±0.88	5.30±1.01	108.7	-19.2	0.000
Perceived barriers	9.11±0.88	4.68±1.53	- 48.6	-24	0.000
Cues to action	5.20±1.60	8.45±1.14	62.5	-14	0.000
Self-efficacy	7.66±1.98	11.7±1.66	52.7	-13	0.000
Total	26.8±5.26	46.2±3.93	72.4	-26.3	0.000

t: paired sample t-test

Table (6): Mean differences between Type 2 Diabetic Patients' Knowledge Score, Self-care Practices Score, BMI, and Blood Glucose Level Pre and Post-Application of Health Belief Model. (n=72).

Items	Pre-intervention ±S.D	Post-intervention ±S.D	% of change	t-value	*P*
Total knowledge score (88 marks)	28.8±12.4	74.3±10.5	1.57	-24.6	0.000
Total self-care practices score (12 marks)	4±2.05	9.1±1.36	1.27	-19.8	0.000
Blood glucose level (mg/dl)	175.3 ±80.4	143.5 ±52.4	-0.18	6.69	0.000
Body mass index (BMI) (Kg/m^2)	34.4±5.09	33.3 ±4.7	-0.03	6.35	0.000

χ^2:Chi-square test **t**: paired t test

Discussion

The present study revealed that the type 2 diabetic patients had a poor score level of knowledge pre-application of HBM educational intervention. This finding could be explained by the fact that many of them were less educated and indicating a lack of continuous health education. This finding is in accordance with (Jarab et al., 2018). However, a significant improvement in the level of knowledge was observed among them post-application of the HBM intervention. The conceivable clarification is that diabetic patients recognized the importance of type 2 diabetes mellitus

management and brought to light the success that has been achieved in the provided educational intervention based on HBM. This is in line with the findings of a study conducted by (Atak et al 2008).

Following HBM intervention completion, substantial satisfactory changes in dietary habits, physical activity, blood glucose level, and adherence to medication regimen were concluded by (Amira S & Fatma A., 2019; Mardani et al., 2010; Al Hayek et al., 2013; Mokabel et al., 2017 and Abdulah et al., 2018) that support the findings of this present study. A slight decline in patients' weight and consequently in BMI after the intervention was revealed. This is attributed to the adoption of a healthy lifestyle. On a similar line, (Asaad et al., 2016) stated overall improvement in diabetic patients' weight and BMI following the study intervention. However, these findings were in contradiction with (Abdulah et al., 2018).

Baseline analysis and three months follow-up clearly demonstrated an increase in the mean scores of perceived susceptibility, perceived severity, perceived benefits, cues to actions, and self-efficacy, and a decrease in the mean score of perceived barriers post-application of the HBM educational intervention. This could be interpreted as involvement in this HBM educational intervention expanding the patients' knowledge level, self-care practices and health beliefs regarding type 2 diabetes mellitus. Accordingly, the study hypothesis was accepted. (Bayat et al., 2013; Solhi et al., 2014 & Shabibi et al., 2017) were in the same line. Furthermore, an experimental research carried out by Aghamolai et al., (2006) showed that a noteworthy increase happened in all model constructs and the perceived barriers construct decreased significantly after the educational intervention. Also, Sharifirad et al., (2008) reported the same findings.

As presented by the results of the current study, patients' participation in the HBM educational intervention increased their mean score of perceived susceptibility and perceived severity post-application of the HBM educational intervention ($p<0.001$). These findings are viewed as consistent with (Molaei et al. 2005; Gahanloo et al., 2008 and Baghianimoghadam et al., 2010). Furthermore, the findings of this study are consistent with those of Baghiani et al., (2014), who used HBM and found an increase in the mean perceived severity score in his educational intervention.

The results of a study conducted by Shamsi et al., (2010) showed an increase in the mean scores of perceived benefits after the intervention, which matched our findings. Moreover, similar studies carried out by Sharifirad et al., (2009) and Mardani et al., (2010) verified these findings. This rising could increase the motivation and tendency among patients about self-care behaviors and adherence to them. The perceived barriers' mean score was declined significantly post HBM educational intervention since education must provide a foundation for the patients to comprehend fewer barriers in the manner towards educational purposes. Molaei et al., (2005) and Koch, (2002) declared in their studies that perceived barriers considerably decreased after education.

Vohs & Baumeister, (2004) confirmed that individuals will be more likely to keep in the recommended health

behaviors if they develop abilities of self-regulation to modify their health behaviors. A significant increase in self-efficacy mean score was observed post-HBM intervention compared to pre-intervention. Compatible with the current study findings, the studies of (McGowan, 2011 & van der Heijden et al., 2012 & Borhani et al., 2015).

Following the application of the health belief model, there was a positive significant correlation between type 2 diabetic patients' knowledge, self-care practices, and health beliefs. A possible explanation: as the patients' knowledge increased, they usually experienced a change in their attitudes and behaviors, and these behavior adaptations caused improvement in self-care behavior as a consequence of the educational intervention. Proving the same point was the study performed by Bigdeli et al., (2016).

A recent systematic review and meta-analysis concluded that knowing the exact level of health belief can be a useful guide for predicting the efficiency of health interventions in the community. Widespread informing throughout the mass media, improving the intellectual maturity' level of the community, surveying, and taking into account diabetes as a global issue has led to a significant increase in positive behaviors in patients (Khosravizadeh et al., 2021). Generally speaking, findings of the current study supported that the application of HBM among type 2 diabetic patients would be effective in increasing their knowledge, self-care practices, and health beliefs and in this way can control type 2 diabetes mellitus and prevent its possible related complications.

Conclusion:

Application of the HBM model proved to be effective in increasing knowledge, promoting the self-care practices and health beliefs of patients with type 2 diabetes mellitus, therefore this model can be used as a framework for applying educational interventions to control type 2 diabetes mellitus.

Recommendations:

Supporting, continuous, and well-designed training programs for healthcare professionals should be established to apply HBM on chronic disease prevention and control.

Strength and limitations of the study:

In this study, the HBM model was used to investigate the factors important to understanding self-management behaviors in a group of type 2 diabetes patients in Egypt. However, the study was not free from the flaws. Self-care practices were measured by a self-report method and that was dependent on patients' recall of their habits and medication-taking practices, and overestimation and measurement bias could happen.

Acknowledgments:

The researchers gratefully acknowledge the study participants for their kind participation and tolerance in this study and all those who partook in this study.

Funding:

There was no external funding for this study.

Disclosure:

None to declare.

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