Original Article

Determinants of Lifestyle Behavior in Iranian Adults with Prediabetes: Applying the Theory of Planned Behavior

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Abstract

Objective: Prediabetic condition can lead to development of type 2 diabetes, especially in individuals who do not adhere to a healthy lifestyle. The aim of the present study was to investigate the socio-cognitive factors using the Theory of Planned Behavior (TPB) that may be associated with the choice of lifestyle in prediabetic patients.

Methods: A prospective study with one-month follow up was designed to collect data from 350 individuals with prediabetic conditions. A questionnaire was used to collect the information, including demographic variables, exercise behavior, food consumption, as well as the constructs of the TPB (attitude, subjective norms, perceived behavioral control, and behavioral intention) regarding physical activity and dietary choice. The correlations between TPB variables and the dependent variables (dietary choice, physical activity) were assessed using Spearman correlation and multiple regression models.

Result: In total, 303 people participated. The mean age of the participants was 53.0 (SD = 11.5) years and 42% were males. Significant correlations were found between all TPB constructs and both dependent variables (healthy eating and exercise behaviors) both at baseline and after one month ($P < 0.01$). The predictive validity of the TPB over time was proved for both dependent variables where past and future behaviors were significantly correlated with the constructs. Nearly 87% of the variance in exercise behavior and 72% of the variance in healthy eating behavior were explainable by TPB constructs.

Conclusion: The TPB may be a useful model to predict behaviors of physical activity and dietary choice among prediabetic people. Therefore, it may be used to monitor lifestyle modification to prevent development of diabetes among people with prediabetic conditions.

Keywords: Planned behavior, prediabetic condition, type 2 diabetes

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Introduction

Type 2 diabetes is considered a leading cause of disability and mortality.[1] It has been estimated that 10% of the world population will live with diabetes by 2030.[2] Prediabetes is defined as the condition in which people have impaired fasting glucose (IFG) and impaired glucose tolerance (IGT).[3] IFG is characterized by elevated fasting plasma glucose (FPG) concentration (between 100–126 mg/dL), while IGT is defined as elevated plasma glucose concentration (between 140 and 200 mg/dL) 2 hours after a 75-g oral glucose load during the oral glucose tolerance test (OGTT) when the FPG concentration is below 126 mg/dL.[3] Prediabteic people are at high risk of developing type 2 diabetes as it has been estimated that up to 70% people with prediabetic condition will eventually become diabetic.[3] Furthermore, approximately 5–10% of prediabteic people develop type 2 diabetes each year.[4] People with prediabetes are also at higher risk of developing cardiovascular diseases as well as other diabetic complications compared with nondiabetic subjects.[5] According to the U.S. National Health and Nutrition Examination Survey, 35% of U.S. adults aged ≥20 years and 50% of those aged ≥ 65 years had prediabetes between 2005–2008.[6] In Iran, a developing country, 4.4 millions of Iranian adults (16.8%) were reported to have prediabetes in 2007.[7]

There is encouraging evidence to support lifestyle modification as the cornerstone of diabetes prevention programs.[4] Therefore, a successful lifestyle intervention could prevent or delay the development of diabetes in people at risk of diabetes. However, self-management plays a significant role in adopting healthy lifestyle behaviors. In order to achieve successful self-management, several self-care behaviors are needed, such as regular physical activity, healthy eating behavior, and blood glucose self-monitoring.[8] Performing self-care behaviors is affected by factors such as habit, routine, and lifestyle. These factors may require day-to-day decisions to perform and maintain.[9] People's belief and attitude (as motivational factors) influence PA and dietary behaviors.[10] The Theory of Planned Behavior (TPB) can be used as a framework to examine PA and healthy eating behaviors. The TPB is a well-known social cognitive theory in

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which intention is the immediate motivation of a certain behavior. Moreover, intention is based on the attitude toward that behavior, subjective norm, and perceived behavioral control (PBC).[11] The TPB has been used in a wide range of behavioral contexts, such as oral health,[12] recycling,[13] using health services,[14] and medication adherence.[15] A few studies have assessed this model among adults at risk for diabetes.[16–21] A recently published systematic review of 16 studies using TPB in adults at risk of diabetes and those with type 2 diabetes suggested that most studies were not prospective and at risk of bias in reporting the reliability.[10] Moreover, PA was commonly evaluated in these studies, whereas only one study assessed the dietary behavior.[10] Thus, this study aimed to understand the possible associations between the TPB variables and lifestyle behaviors (PA and healthy eating behaviors) in a cohort of Iranian adults at risk of type 2 diabetes (prediabetes).

Materials and Methods

This prospective study was performed in cities of Tehran and Qazvin, Iran from November 2014 to April 2015.

Participants

Participates were selected from twelve health centers in Tehran and Qazvin. In each city, six health centers were randomly selected from 89 and 19 health centers in Tehran and Qazvin, respectively. All medical information of the participants in the catchment areas is kept in health centers. There is a registry profile for prediabetic and diabetic patients in each health center. Three hundred and fifty adults were selected randomly from the in-house files and subsequently invited to participate in this study. Forty seven (11.4%) patients refused to participate. The inclusion criteria were: age 18–75 years, diagnosis of impaired FPG (100–125 mg/dL) or IGT during OGTT (2-h postprandial glucose 140–199 mg/dL),[22] and signing the informed consent form. The patients were excluded if they were pregnant or refused to participate.

Measures

Socio-demographic variables

Sociodemographic characteristics (i.e., age, gender, monthly family income, accommodation type, marital status, and employment status) were obtained from the participants' medical records. Anthropometric characteristics including body weight, height, body mass index (BMI), and waist circumference (WC) were measured by standard methods as per medical practice. Blood pressure (BP) was measured on both arms with a digital sphygmomanometer after 5 minutes of quiet rest.

TPB questionnaire for PA

The attitude toward PA was measured using a five-point semantic differential scale. For example: for me to exercise for at least 30 min, 5 days per week at a moderate intensity over the next month would be 'harmful-beneficial', 'bad-good', 'unpleasant-pleasant', 'worthless- useful' and 'unfavorable-favorable'. The average score of the five items served as the measure of the attitude.[23] Higher scores indicated a more positive attitude toward physical activity.

Subjective norms

Subjective norm was determined using three items on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).[23] For example, 'People who are important to me would approve of me exercising for at least 30 min, 5 days per week at a moderate intensity over the next month'.

Perceived behavioral control

Four items were used to measure the perceived behavioral control. The items were rated using a 5-point Likert type scale ranging from 1 (extremely hard) to 5 (extremely easy).[23] For example: "Exercising for at least 30 min, 5 days per week at a moderate intensity over the next month would be…".

Behavioral intention

The participant's willingness to exercise was assessed using two items on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).[23] For example, 'I intend to exercise for at least 30 min, 5 days per week at a moderate intensity over the next month'.

Physical activity

Exercise behavior was measured using a modified and validated version of Godin Leisure Time Exercise Questionnaire (GLTEQ).[24,25] In the questionnaire, the participants were asked to indicate the average duration and frequency of mild, moderate, and tense physical activities per week over the past month. The participant's responses were then converted to METS (a unit representing oxygen consumption during PA) using the following equation: $\sum [(\text{mild} \times 2.5) + (\text{moderate} \times 4.0) + (\text{tense} \times 7.5)]$.[26,27] According to the public health guidelines, a healthy adult should achieve a minimum of 600 MET-minutes per week (MET·min·wk^{-1}) to meet the guideline of adequate PA.[27] It should be noted that this cutoff point is equivalent to moderate-tense activities.[27]

TPB questionnaire on healthy eating

Attitude

The participants were asked to indicate their attitude towards eating food low in saturated fat in four 2-point semantic items: "For me eating healthy foods daily over the next month would be: unpleasant/pleasant, bad/good, negative/positive, and unfavorable/favorable". All items were averaged to calculate the overall attitude score.[28,29]

Subjective norms

Subjective norm was measured by three items on a 5-point scale, reflecting the perceived pressure to eat healthy from the significant others. For example, 'People who are important to me would approve of me eating healthy food daily over the next month'. Higher scores represented stronger perception of subjective norms.[29]

Perceived behavioral control

The participant's control/confidence over eating healthy food daily was assessed using four Likert-type items. For example, 'I have complete control over whether I eat healthy food daily during the next month'. All responses were scored by a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Behavioral intention

The intention to eat healthy food was measured by two questions regarding one's willingness to eat healthy food over the next month. For example, 'In the next month, I intend to eat healthy food everyday'. The responses were scored by a 5-point Likert

scale ranging from 1 (strongly disagree) to 5 (strongly agree).[29]

Fruit and vegetable consumption

A short self-reporting measure was used to assess the consumption of fruit and vegetable. This two-item measure has been validated in previous studies.[30,31] The participants were asked to record the number of servings in a typical day. 'Over the last 2 weeks, I had (insert a number) ____ serving(s) of fruit in a typical day" and "Over the last 2 weeks, I had (insert a number) ____ serving(s) of vegetable in a typical day". Moreover, all participants were provided an example of the serving size for fruit and vegetable before completing the questionnaire.

Consumption of food low in saturated fat

The intake of saturated fat was measured using a single item. The participants were asked to indicate the extent to which they had eaten foods low in saturated fat (e.g., low-fat dairy products, fat trimmed meat, and mono- and poly-unsaturated oils) in the last month. All the responses were rated on a 5-point scale from 1 (small extent) to 5 (large extent), with a lower score indicating a higher intake of saturated fat. To improve the reliability of this single measure, a checklist was used. The participants used the checklist to recall the foods low in saturated fat consumed in the last month.[16]

Procedure

This is a prospective study with a short (one month) follow up period. All eligible participants were invited to the health centers. The aims of the study were discussed with the participants, who were then asked to read and sign the informed consent form. All participants were provided with a definition of PA and healthy eating behavior. A trained GP who was blind to the study aims measured the anthropometric characteristics and blood pressure of all participants. The participants then completed the baseline measures, including attitude, subjective norms, perceived behavioral control, intention, fruit and vegetable consumption, and the consumption of food low in saturated fats. One month later, the participants were asked to complete two measures, including fruit and vegetable consumption and the consumption of foods low in saturated fat.

Statistical analysis

Data analysis was carried out using SPSS Statistics (version 20.0, for Windows). Descriptive statistics were used to examine TPB variables for exercise and healthy eating behavior, as well as sociodemographic variables. Spearman correlations were used to evaluate the correlation between each TPB variable and exercise and healthy eating behaviors.

A series of hierarchical multiple regression analyses were performed to evaluate how well TPB variable can predict physical exercise and the consumption of foods low in saturated fat as well as fruits and vegetables. A series of zero-order correlation analyses between each of the sociodemographic variables and target behaviors (physical exercise, the consumption of food low in saturated fat as well as fruits and vegetables) were performed to identify confounders of the main analyses (correlation was significant at 0.01 level). For all models, previous behavior and potential sociodemographic confounders were entered in Step 1; while the attitude, subjective norms and PBC were entered in Step 2. Behavioral intention was entered in Step 3. In order to eliminate multicollinearity, all predictors were centered prior to analysis.[32] $P < 0.05$ was considered significant.

Results

In total, 303 adults with prediabetes participated in the study. Among them, 14 (4.62%) did not complete the 1-month follow-up questionnaire. There was no significant difference in sociodemographic characteristics or TPB variables between the dropouts and those who completed the study. The mean age of the prediabetic participants was 53.0 ± 11.5 years with 217 (71.6%) males. The average education was 5.8 ± 3.9 years. The majority of the participants were married (86.1%) and lived in urban areas (82.8%). The mean BMI was 27.0 ± 4.8 kg/m^2, ranging 19.2 to 35.1. The sociodemographic characteristics of the participants are presented in Table 1.

Table 1. Demographic characteristics of the participants.

	Value
Age (years)	52.9 ± 11.5
Years of education	5.8 ± 3.9
Monthly income ($)	352 ± 294
Gender	
Male	217 (71.6%)
Female	86 (28.4%)
Marital status	
Married	261 (86.1%)
Single	19 (6.3%)
Divorced/widowed	23 (7.6%)
Accommodation	
Urban	251 (82.8%)
Rural	52 (17.2%)
Employment status	
Employed	216 (71.3%)
Unemployed	87 (28.7%)
Waist–hip ratio	0.88 ± 0.10
Systolic blood pressure (mmHg)	132 ± 19
Diastolic blood pressure (mmHg)	79.48 ± 10.3
BMI (kg/m^2)	27.0 ± 4.8

The results are expressed as mean ± standard deviation. N= 303. BMI: body mass index.

Table 2. The correlations between the TPB variables and physical activity behavior at time 1 and time 2.

	Mean (SD)	Cronbach's alpha	1	2	3	4	5	6
1. Physical activity Time 1‡	703.34 (99.04)	-	1					
2. Physical activity Time 2	700.53 (93.88)	-	.71**	1				
3. PBC Time 1	3.41 (2.04)	0.90	.39**	.42**	1			
4. Intention Time 1	3.08 (1.95)	0.96	.47**	.53**	.31**	1		
5. Subjective norms Time 1	3.47 (1.60)	0.89	.30**	.31**	.41**	.46**	1	
6. Attitude Time 1	2.60 (1.08)	0.89	.29**	.32**	.39**	.29**	.44**	1

‡Weekly MET-minutes Mild, moderate and vigorous activity. ** $P < 0.01$. PBC = perceived behavioral control; SD: Standard Deviation; TPB: Theory of Planned Behavior.

Table 3. The intercorrelations between the TPB variables and healthy eating behavior at time 1 and time 2.

	Mean (SD)	Cronbach's alpha	1	2	3	4	5	6	7	8
1. 5-A-Day Time 1‡	3.26 (1.67)	0.93	1							
2. 5-A-Day Time 2	3.31 (1.79)	0.94	.40**	1						
3. self-reported consumption of foods low in saturated fats Time 1	3.12 (1.01)	-	.31**	.24**	1					
4. self-report edconsumption of foods low in saturated fats Time 2	3.18 (1.21)	-	.27**	.30**	.26**	1				
5. PBC Time 1	2.97 (1.22)	0.92	.28**	.31**	.30**	.33**	1			
6. Intention Time 1	2.94 (0.93)	0.88	.30**	.29**	.28**	.32**	.38**	1		
7. Subjective norms Time 1	3.32 (1.49)	0.83	.25**	.28**	.24**	.29**	.35**	.41**	1	
8. Attitude Time 1	3.64 (1.05)	0.93	.23**	.29**	.26**	.25**	.34**	.26**	.37**	1

‡ servings/day; ** $P < 0.01$; PBC = perceived behavioral control; SD: Standard Deviation; TPB: Theory of Planned Behavior.

Table 2 demonstrates the internal consistency and correlation between TPB variables and exercise behavior. All TBP variables for exercise behavior exceeded the threshold of 0.70 for internal consistency as assessed by Cronbach's alpha. All TPB variables significantly correlated with behavioral intention (r ranged between 0.29 and 0.53) and exercise behavior (r ranged between 0.29 and 0.47, $P < 0.01$). Previous exercise behavior significantly correlated with future exercise behavior ($r = 0.71$, $P < 0.01$).

As expected, the intention to consume fruit and vegetable was significantly correlated with attitudes, subjective norms, perceived behavioral control, and previous fruit and vegetable consumption (Table 3). Previous fruit and vegetable consumption was significantly correlated with future fruit and vegetable intake ($r = 0.40$, $P < 0.01$). Strong internal consistency was found for all TPB variables in determining healthy eating behavior. The consumption of foods low in saturated fat was also positively correlated with all TPB variables (r ranged between 0.24 and 0.36, $P < 0.01$) as well as fruit and vegetable consumption (r ranged from 0.27 to 0.30, $P < 0.01$).

A series of hierarchical linear regression analyses were performed to examine the predictive validity of the TPB variables in physical exercise and the intake of fruit, vegetables and foods low in saturated fat. For exercise behavior, previous behavior, pre-intentional measures (i.e., the attitude, subjective norms and PBC) and behavioral intention were entered sequentially into the regression equations after controlling for socio-demographic variables (i.e. age, sex, monthly income, and BMI). Hierarchical linear regression analysis (Table 4) revealed that previous exercise behavior together with age, sex, income and BMI can account for 49% of the variance in future exercise behavior ($F = 51.43$, $P < 0.01$). Moreover, men were more likely to exercise regularly than women ($B = 2.38$, $P < 0.01$). Adding the attitude, subjective norms and PβC in the Step 2 significantly improved the prediction by 28%. Adding the behavioral intention contributed a further 10% increase in the efficacy of TPB prediction (Table 4). The attitude, subjective norms and PBC increased the predictive variance of the model to 77%; while behavioral intention further increased the predictive variance to 78%.

A hierarchical multiple regression analysis was performed in which fruit and vegetable consumption was regressed into the TPB variables after adjusting for sociodemographic variables. As presented in Table 5, previous fruit and vegetable consumption, age, gender and education accounted for 38% of the variance in predicting future fruit and vegetable consumption. Addition of attitude, subjective norms and PBC in Step 2 increased the prediction of future fruit and vegetable consumption by 22%. The addition of behavioral intention in Step 3 improved the prediction of future fruit and vegetable consumption by 12%. The final model accounted for 72% of the variance in future fruit and vegetable consumption.

To determine which TPB variables can predict the consumption of foods low in saturated fat, hierarchical multiple regression

Table 4. The summary of hierarchical regression analysis of the variables predicting physical activity (N = 303).

Variable	Model 1		Model 2		Model 3	
	β	LLCI/ULCI	β	LLCI/ULCI	β	LLCI/ULCI
Sociodemographic						
Age	0.09	-0.06/1.80	0.54	-0.27/0.98	-0.57	-0.45/0.75
Sex [a]	2.38	1.43/5.72	1.43	0.10/3.06	1.24	-0.08/2.74
Income	1.63	-1.58/1.85	0.59	0.02/2.34	1.25	0.05/2.2
BMI	-0.27	-0.13/0.33	0.16	-0.06/0.25	0.14	-0.05/0.24
Past behavior (Time 1)	0.64	0.62/0.81	0.27	0.22/0.38	0.24	0.20/0.35
Attitude			3.31	2.67/4.32	2.87	2.51/4.10
Subjective norms			2.69	2.08/3.96	1.45	0.99/2.97
Perceived behavioral control			4.21	3.93/5.53	3.37	2.70/4.47
Behavioral intention					3.25	1.81/4.13
R^2 change	0.49		0.28		0.10	
F change	51.43		110.10		65.63	

LLCI = Lower Limit of the β 95% Confidence Interval. 95% ULCI = Upper Limit of the β 95% Confidence Interval. The numbers in bold indicate $P < 0.05$.

Table 5. The summary of hierarchical regression analysis of the variables predicting fruit and vegetable consumption (N = 303).

Variable	Model 1		Model 2		Model 3	
	β	LLCI/ULCI	β	LLCI/ULCI	β	LLCI/ULCI
Sociodemographics						
Age	-0.38	-0.14/1.58	-0.52	-0.74/0.55	-0.59	-0.53/0.66
Sex[a]	2.97	1.71/5.40	1.82	0.23/2.97	1.38	0.30/2.90
Education	1.68	-1.16/2.10	1.34	0.15/2.49	1.06	0.02/2.20
Past behavior (Time 1)	0.63	0.60/0.80	0.27	0.22/0.39	0.23	0.17/0.33
Attitude			1.93	0.63/2.78	1.52	0.52/2.55
Subjective norms			4.42	3.07/5.04	2.27	1.72/3.57
Perceived behavioral control			4.72	2.58/5.10	4.31	2.58/4.94
Behavioral intention					2.79	1.63/3.23
R^2 change	0.38		0.22		0.12	
F change	66.74		94.05		35.82	

LLCI = Lower Limit of the β 95% Confidence Interval. 95% ULCI = Upper Limit of the β 95% Confidence Interval.
The numbers in bold indicate $P < 0.05$.

Table 6. The summary of hierarchical regression analysis of the variables predicting the consumption of food low in saturated fat (N = 303).

Variable	Model 1		Model 2		Model 3	
	β	LLCI/ULCI	β	LLCI/ULCI	β	LLCI/ULCI
Sociodemographic						
Age	0.59	0.13/0.1.51	0.44	-0.43/0.48	-0.42	-0.38/0.50
Sex [a]	3.81	2.09/4.85	1.02	-0.51/1.38	0.98	-0.14/1.66
Education	1.47	0.13/2.28	1.82	1.01/2.70	1.64	1.08/2.60
Income	-0.19	-0.01/0.32	0.29	0.4/0.25	0.18	0.03/0.24
Past behavior (Time 1)	0.54	0.52/0.67	0.16	0.13/0.25	0.14	0.12/0.23
Attitude			1.26	0.79/2.02	0.17	0.93/2.10
Subjective norms			2.73	2.32/3.80	1.84	1.44/2.92
Perceived behavioral control			4.40	4.01/5.60	4.38	3.82/5.32
Behavioral intention					2.19	1.77/2.91
R^2 change	0.31		0.37		0.08	
F change	62.64		268.22		75.84	

LLCI = Lower Limit of the β 95% Confidence Interval. 95% ULCI = Upper Limit of the β 95% Confidence Interval
The numbers in bold indicate $P < 0.05$.

analysis was performed. The results in Table 6 showed that in Step 1, previous behavior of saturated fat consumption, age, gender, education and income can predict 31% of the variance in the consumption of food low in saturated fat (Table 6). In Step 2, addition of attitude, subjective norms and PBC increased the predictive power of the model to 68%. In Step 3, the predictive power of the model was further improved to 76% by adding behavioral intention (Table 6).

Discussion

A number of epidemiological studies have shown that PA and healthy eating behavior can reduce the risk of developing type 2 diabetes. Therefore, this study aimed to evaluate whether TPB can predict three lifestyle behaviors (including physical activity, fruit and vegetable consumption, and the intake of foods low in saturated fat) in a cohort of Iranian adults at high risk of developing type 2 diabetes. There was some evidence to suggest that attitude, subjective norms, and PBC can predict people's intention to exercise. Furthermore, the attitudes and subjective norms, PBC and behavioral intention have been found to be strong predictors of physical activity at 1-month follow-up. In this study, intention and PBC are the strongest predictors of physical activity. The results of our study are consistent with those of a meta-analysis by Armitage *et al*. where PBC was the strongest predictor of PA behavior.[33] PBC can help to identify personal and environmental factors which are not completely under control. Therefore, it could be concluded that performing PA in patients at risk of developing type 2 diabetes is more influenced by volitional control than the other TPB variables. Similar findings were reported for using PA for weight loss maintenance.[20,34] Subjective norms were found to be a significant but weak predictor of PA in the participants. This is in agreement with the results of previous studies.[17,33] However, subjection norms were not found to be a significant predictor for the intention to perform PA in a previous study.[10] It could be proposed that the differences between the studies might be due to the diffidence in the populations selected and their conditions [11]. Overall, the TPB can explain 28% of the variance in PA intention and 38% of those in PA behavior without considering previous PA behavior and gender. Our results are consistent with two meta-analyses in which the TPB explained approximately 30–46% of the variance in PA intention and 21–27% of that in PA behavior.[35,36] In a recent systematic review, the variances for PA intentions and PA behavior were 31–73% and 8–28%, respectively in prospective studies.[10]

The current study showed that Iranian women were less likely to engage in adequate PA than men. Iranian women have some special social and cultural constraints, including sociocultural expectations and environmental constraints. Moreover, Iranian women are responsible for all child care duties, which prevents mothers from participating in PA programs.[37]

For healthy eating behaviors, the results indicated that all TPB variables were strongly associated with the intention to consume healthy diet; PBC and intention were also associated with the consumption of fruit, vegetable, and foods low in saturated fat. Consistent with the literature,[17,38] PBC was the major predictor for the consumption of fruit, vegetable, and foods low in saturated fat. Overall, the TPB explained 22% and 37% of the variance in the intention to consume healthy diet. Moreover, the TPB explained 34% and 45% of the variance in the fruit and vegetable consumption, and consumption of food low in saturated fat, respectively without taking into consideration previous eating behavior and gender. Our results are consistent with the findings in previous studies.[10,16] Previous behavior was found to be the strongest predictor in all behaviors including PA and healthy eating behavior. Including previous behavior in all the TPB models can significantly improve the prediction of future behaviors by at least 30%. Previous behavior could be considered as a habit and thus a predictor for many repeated behaviors on a regular basis. In a meta-analysis of 64 studies, Ouellette and Wood found that past behavior was a strong predictor of future behavior, which is even stronger than the intention. Our results are comparable to that of Ouellette and Wood.[39]

There are still some limitations in the present study. First, all the measures were self-reported. Second, this study was performed in a short time frame. Thus, future studies should assess the predictability of the TPB over a longer time frame.

In conclusion, the TPB variance, including attitude, subjective norms, perceived behavioral control, and intention can successfully predict the behavior of PA and healthy dietary choice for at least 1 month. Thus, the TPB may be used as a predictive model and monitoring tool to implement lifestyle modification among prediabetic patients to prevent or slow down the development of type 2 diabetes.

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