

Predicting Stage of Exercise Among Patients with Type 2 Diabetes: A Test of the Extended Theory of Planned Behavior

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Purpose: This study aimed to predict stage of exercise among Chinese patients with type 2 diabetes by using an extended theory of planned behavior model (TPB) incorporating descriptive norm and self-identity.

Patients and Methods: Participants ($N=791$) were included in a cross-sectional study. Structural equation modeling was used to explain how the extended TPB could predict the stage of exercise.

Results: The model accounted for 41% of the variance in stage of exercise and 81.1% of the variance in intention. Intention ($\beta=0.359$, $P<0.01$) and self-identity ($\beta=0.236$, $P<0.001$) had a direct effect on stage of exercise. Self-identity ($\beta=0.261$, $P<0.001$), descriptive norm ($\beta=0.035$, $P<0.05$) and PBC ($\beta=0.683$, $P<0.001$) were strong predictors of intention. The effects of self-identity and PBC on behavior were significantly mediated via intention. Age, BMI and stage of diet behavior were found to be significantly related to intention and behavior.

Conclusion: This study has tested the usefulness of the extended TPB for explaining exercise in Chinese diabetic patients. To promote patients to start or continue exercising, interventions should target self-identity and controllability for physical activity.

Keywords: theory of planned behavior, stage of change, exercise, descriptive norm, self-identity

Introduction

Engaging in exercise is a crucial component of developing a healthy lifestyle among Chinese adults. The Chinese Guideline for Diabetes Prevention and Management (2017) recommended that patients with type 2 diabetes could control their blood glucose through modifying lifestyles, such as healthy diet and sufficient exercise. Enormous epidemiological studies have found that regular exercise could help the body to increase insulin sensitivity and control blood glucose.¹ However, many Chinese patients still have not become physically active, especially young patients.²

Many theories have been used to explain what factors influence exercise behavior and the interrelationship between them. The theory of planned behavior (TPB) has been used extensively in the prediction of exercise and it has shown great and robust efficacy and predictive utility in explaining physical activity. The TPB is considered a continuous model, which means that attitude, subjective norm, or perceived behavior control (PBC) are positively associated with one's intention and behavior.³ Even though the TPB has been successfully used to predict exercise behavior, subjective norm, one construct contained within the TPB, has not

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performed very well. It's probably because subjective norm may not be the most theoretically relevant social influence construct for understanding exercise behavior. Recently, two variables – self-identity and descriptive norm – have been discussed for inclusion as additional predictors of exercise intention and behavior within the TPB.^{4,5} Subjective norm has been identified as the individual's perception about what significant others think ought to be done.⁶ Recently, Ajzen and Fishbein stated that the subjective norm construct should also include the individual's perception about what significant others do (descriptive norm).⁷ Many studies have tested the predictive ability of descriptive norm, but the results were inconsistent.⁸ In the Chinese context, important others such as friends may have strong social control on one's behavior. For example, friends who are physically active may have more social control over one's participation in exercise.⁹ However, some studies found that descriptive norm cannot predict exercise intention in English high school students,⁸ whereas other studies found that a statistically significant effect of descriptive norm on intention across various behavioral domains, the relationship between descriptive norm and exercise intention, might be stronger in younger samples.¹⁰ It is still inconclusive whether the role of descriptive norm could augment the TPB in predicting exercise intention and behavior itself.

Self-identity originated with identity theory and indicated the salient part of an individual's self that relates to a particular behavior.¹¹ Normally, individuals are more likely to act in accordance with their self-identity to validate their status as a role member. In people who identify strongly as physically active, the exercise behavior becomes an important part of their self-concept, in turn influencing their motivation to exercise.¹² A meta-analysis that found self-identity could account for an additional 1% of the variance in exercise intentions over and above the traditional TPB constructs.¹³ A meta-analysis found that self-identity could exert a direct influence on behavior itself in the exercise domain.⁵ Despite the research supporting the influence of self-identity on behavioral intention, there is no research exploring the role of self-identity within the TPB in relation to exercise in Chinese patients with type 2 diabetes.

The most popular measure of the temporal dimension of health behavior change was stage of change (SOC), which was the central construct of the transtheoretical model developed by Prochaska and DiClemente.¹⁴ SOC

highlighted the dynamic nature of health behavior change: changes in a health behavior consist of movements through stages, such as precontemplation, contemplation, preparation, action, and maintenance. Increasing evidence has incorporated TPB to predict stage of behavior.^{15,16} The TPB and SOC have been used in the exercise domain, but the TPB may be a more comprehensive and sophisticated model for explaining why people change their health behaviors.¹⁵ Many studies have used TPB as a framework for understanding the stages of change in the western context,¹⁷ but no studies to our knowledge have explored the utility of TPB and additional constructs in predicting exercise in patients with type 2 diabetes. Therefore, we hypothesized that the stage of exercise would be influenced by constructs of extend TPB and intention would be a significant mediator (as shown in Figure 1).

The current study aimed to test the validity of an extended TPB model, incorporating descriptive norm and self-identity as additional variables, for predicting and understanding exercise in Chinese patients with type 2 diabetes.

Materials and Methods

Participants and Procedures

This study was conducted in 22 health stations of Shunyi and Tongzhou districts, Beijing, in 2018. The probability proportional to size sampling method was applied to recruit patients. General practitioners in each health station told their registered patients about this study (by telephone call or onsite inquiry) and asked about their willingness to participate. Participants were eligible for this study if they: had an HbA1c level $\geq 7.5\%$ or were diagnosed with type 2 diabetes were aged 18–70 years old; were permanent residents in Shunyi or Tongzhou district; were without mental retardation, Alzheimer's disease, or other mental disorders; have not engaged in other scientific programs; and agreed to participate. Besides, individuals who have severe diabetes complications or other severe diseases cannot be included. Face-to-face questionnaire data collection were administered by trained professionals (including general practitioners, nurses, and medicine postgraduates). Finally, 819 eligible participants were eligible for our study. Furthermore, individuals who did not provide sufficient information on demographic and lifestyle factors were excluded ($N=28$). Finally, 791 eligible participants were contained in this study.

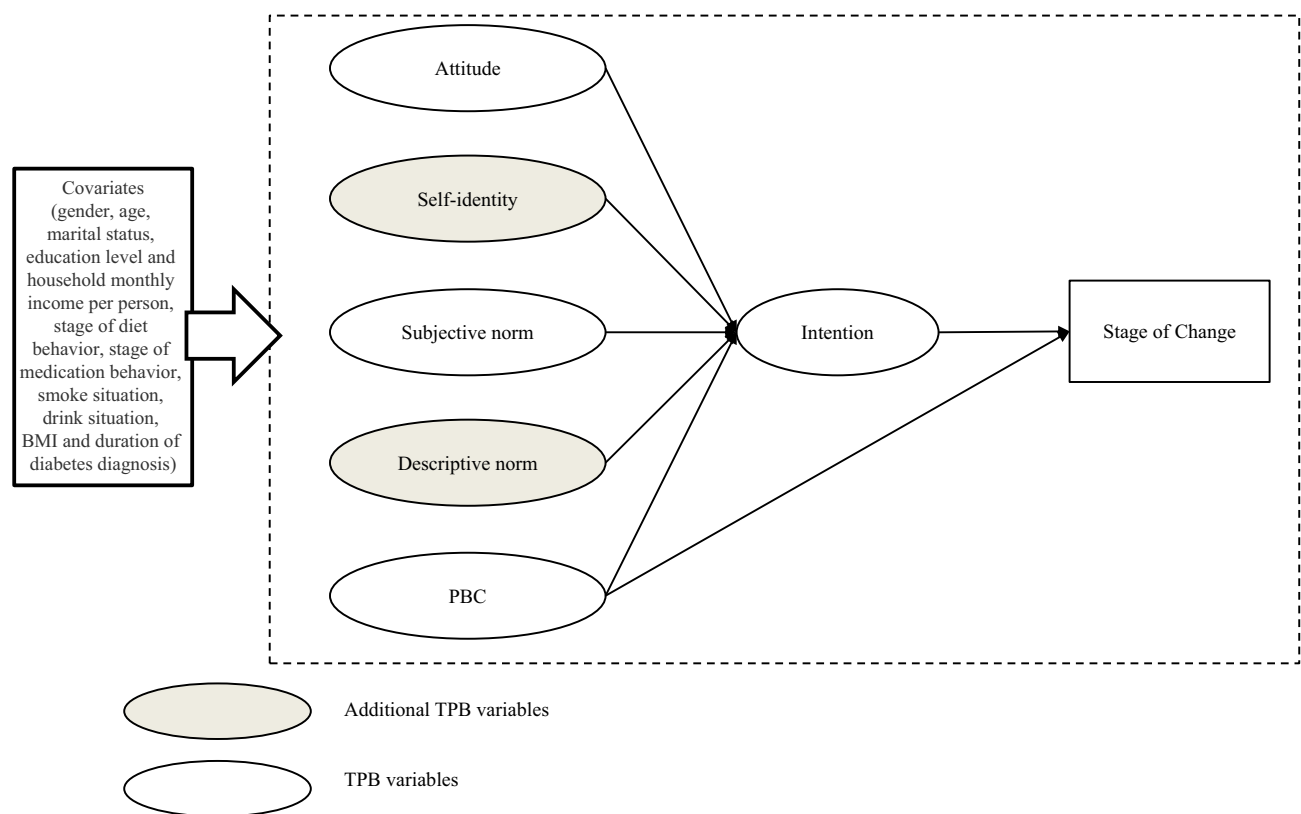


Figure 1 Extended TPB model predicting exercise intention and stage of exercise.

Ethics Statement

This study was approved by Peking University Institutional Review Board (IRB00001052-17044). All participants signed informed consent forms before they were enrolled into the study.

Statistical Analysis

Means, standard deviations, the differences between subgroups (measured by chi-square and *t* tests) were examined using Stata 14.0. Variables were tested for skewness and kurtosis and the differences were measured by Kruskal–Wallis test if not normally distributed. Structural equation modeling was conducted by Mplus 7.0 to estimate the fit of the traditional/extended TPB model and the relationships among the latent constructs, with controlling covariates (including gender, age, marital status, education level and household monthly income per person, stage of diet behavior, stage of medication behavior, smoke situation, drink situation, body mass index (BMI), and duration of diagnosis). The sequence of models tested were: first – intention, attitude, subjective norm, and PBC; second – intention, attitude, self-identity, subjective norm, descriptive norm,

and PBC. The usefulness of the TPB constructs and the additive effect of self-identity and descriptive norm in predicting stage of exercise and exercise intention were estimated. Weighted least squares means and variance (WLSMV) was used to construct and fit the model according to categorical data. The overall fit of the resultant models was assessed by using χ^2/df (chi-square divided by degrees of freedom), root mean squared error of approximation (RMSEA), comparative fit index (CFI), Tucker–Lewis Index (TLI), and WRMR (weighted root mean square residual).

Instruments

The Extended TPB Scale

The reliability and validity of extended TPB scales are presented in [Table S1](#) in supplementary material. Six factors were extracted from the self-designed scale. Attitude and self-identity were measured by a five-point Likert scale (from “completely disagree” to “fully agree”) and were coded as 1–5; intention, subjective norm, descriptive norm, and PBC were measured by a seven-point Likert scale (from “completely disagree” to “fully agree”) and

were coded as 1–7. These factors together could contribute to 77.44% of the sum of the squared loadings. All the items highly loaded on their constructs. The Cronbach's alphas for each factor were as follows: intention (0.958), attitude (0.748), self-identity (0.752), subjective norm (0.648), descriptive norm (0.661), PBC and (0.643).

Stage of Exercise

Stage of exercise was assessed by five-category measure of stage of change in exercise participation.¹⁸ Participants were classified into five categories: (1) precontemplation – do not exercise and do not intend to start; (2) contemplation – do not exercise but consider starting; (3) preparation – do not exercise but plan to start soon; (4) action – already exercise; (5) maintenance – have exercised for 6 months or more.

Covariates

The covariates were gender (categorical, female, male), age (categorical, participants' age was classified into ≤ 50 , 51–55, 56–60, 61–65, ≥ 66), education level (categorical, primary school and below, middle school, high school, university and above), marital status (binary, married, single) and household monthly income per person (categorical, <3000, 3000–3999, 4000–4999, 5000–9999, $\geq 10,000$), stage of diet behavior (categorical, precontemplation, contemplation, preparation, action, and maintenance), stage of medication behavior (categorical, precontemplation, contemplation, preparation, action, maintenance, smoke situation (current smoker, past smoker, nonsmoker), drink situation (current drinker, past drinker, nondrinker), BMI (as a continuous variable, measured by weight in kilograms divided by height in meters squared), duration of diabetes diagnosis (as a continuous variable).

Results

Demographic Characteristics

The demographic profile of the 791 participants is presented in Table 1. In the total population, 52.68% were female, 50.76% were aged 60 years old and over, 93.75% were married, 44.1% finished middle school, more than half of participants were nonsmokers and nondrinkers, and the mean BMI was 26.712 (SD: 3.969).

Significant stage-based differences in age, education level, and BMI have been observed. Participants in the preparation stage were relatively younger and 42.11% of them were aged under 50 years. Participants in the preparation stage had a higher level of education, including

42.11% of them who obtained university and above education. Participants in the precontemplation stage and contemplation stage had significantly higher BMI values.

Factor Scores of the Extended TPB Scale

In Table 2, the extended TPB scores have been normally distributed; therefore, we used the mean and standard deviations to describe scores across the stages of exercise behavior. In general, scores in each construct of extended TPB were relatively higher in advanced stages.

Structural Equation Modeling

As shown in Table 3, the utilities of extended TPB for predicating intention and behavior were tested. Compared with Model 1 and Model 2, R^2 increment in the behavior was 3%, and 4.6% in the intention. Two models present adequate goodness of fit. Model 1: $\chi^2=454.753$, $df=326$, RMSEA=0.022, CFI=0.935, TLI=0.925, WRMR=0.864; Model 2: $\chi^2=759.992$, $df=504$, RMSEA=0.025, CFI=0.900, TLI=0.886, WRMR=0.952. After considering model parsimony, Model 2 was selected as the final model.

The six constructs together explained 40.4% of the variance in exercise behavior and 77.9% of the variance in intention. Intention was the strongest predictor of stage of exercise ($\beta=0.359$, $P<0.001$), explaining 12.9% of the variance of behavior, but the relation between PBC and stage of exercise was not significant ($\beta=0.057$, $P>0.05$). Self-identity ($\beta=0.236$, $P<0.001$) was a strong predictor of stage of exercise. Age group ($\beta=0.100$, $P<0.05$) and BMI ($\beta=-0.091$, $P<0.05$) were also significantly correlated with behavior. PBC ($\beta=0.683$, $P<0.001$) and self-identity ($\beta=0.261$, $P<0.001$) were crucial predictors of intention, and descriptive norm ($\beta=0.035$, $P<0.05$) is another important predictor of intention. Age group ($\beta=0.081$, $P<0.05$) and stage of diet behavior ($\beta=0.153$, $P<0.001$) were significant predictors of exercise intention.

Intention was the most important mediating variable, and the indirect effects of self-identity ($\beta=0.094$, $P<0.001$) and PBC ($\beta=0.245$, $P<0.001$) on exercise behavior through exercise intention were statistically significant.

Discussion

The extended constructs of the TPB have great predictive ability for exercise intention and stage of exercise in Chinese patients with type 2 diabetes. Scores of all constructs were higher in advanced stages of exercise. Overall, 40% of the exercise behavior variance and 77.9% of intention variance were explained by the

Table 1 Sample Characteristics of Included Individuals

	Total	Precontemplation	Contemplation	Preparation	Action	Maintenance	χ^2/F
Gender (%)							3.900
Female	52.68	53.54	54.00	57.89	58.18	49.67	
Male	47.32	46.46	46.00	42.11	41.82	50.33	
Age group (%)							33.171**
≤50	13.01	10.10	22.00	42.11	12.73	11.93	
51–55	15.56	21.21	20.00	5.26	14.55	14.75	
56–60	20.66	18.18	24.00	31.58	21.82	19.74	
61–65	27.04	30.30	16.00	15.79	29.09	26.90	
≥66	23.72	20.20	18.00	5.26	21.82	26.68	
Education level (%)							23.138*
Primary school and below	10.84	16.16	8.00	5.26	12.73	9.33	
Middle school	44.52	49.49	38.00	15.79	45.45	45.12	
High school	26.40	23.23	28.00	36.84	27.27	26.46	
University and above	18.24	11.11	26.00	42.11	14.55	19.09	
Marital status (%)							3.132
Single	6.25	9.09	8.00	10.53	6.06	5.21	
Married	93.75	90.91	92.00	89.47	93.94	94.79	
Household monthly income per person (%)							19.151
<3000	29.34	34.34	20.00	15.79	32.12	28.85	
3000–3999	29.72	36.36	30.00	26.32	28.48	29.28	
4000–4999	13.27	9.09	20.00	15.79	16.36	12.15	
5000–9999	21.17	13.13	24.00	26.32	17.58	23.43	
≥10,000	6.51	7.07	6.00	15.79	5.45	6.29	
Stage of diet behavior							95.584***
Precontemplation	36.73	52.58	22.00	31.58	29.01	37.94	
Contemplation	9.95	11.34	26.00	10.53	9.88	7.89	
Preparation	3.32	4.12	14.00	10.53	3.09	1.75	
Action	6.89	2.06	8.00	10.53	17.28	3.95	
Maintenance	43.11	29.90	30.00	36.84	40.74	48.46	
Stage of medication behavior							34.801***
Precontemplation	8.55	5.15	6.00	0.00	5.56	10.96	
Contemplation	1.02	0.00	0.00	0.00	2.47	0.88	
Preparation	0.26	0.00	0.00	0.00	0.62	0.22	
Action	3.57	3.09	0.00	10.53	8.64	1.97	
Maintenance	86.61	91.75	94.00	89.47	82.72	85.96	
Smoke situation							14.656
Current smoker	24.23	32.99	36.00	21.05	19.75	22.81	
Past smoker	15.18	8.25	8.00	15.79	15.43	17.32	
Nonsmoker	60.59	58.76	56.00	63.16	64.81	59.87	
Drink situation							4.930
Current drinker	30.23	24.74	22.00	31.58	30.86	32.02	
Past drinker	7.53	8.25	12.00	5.26	6.79	7.24	
Nondrinker	62.24	67.01	66.00	63.16	62.35	60.75	
BMI	26.712 (3.969)	27.869 (4.704)	28.116 (4.895)	26.441 (3.459)	26.284 (3.061)	26.474 (3.929)	4.620**
Duration of diagnosis	4.716 (3.493)	5.206 (4.156)	4.760 (3.127)	4.263 (2.746)	4.462 (2.852)	4.715 (3.612)	0.770
N	791	104	50	19	162	456	

Notes: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Table 2 Means (Standard Deviations) of Each Construct in Extended TPB Across Four Stages of Exercise

	Precontemplation	Contemplation	Preparation	Action	Maintenance	χ^2	P
Intention	18.707 (12.123)	32.280 (12.401)	35.526 (11.202)	43.170 (9.553)	43.591 (9.021)	218.80	0.000
Attitude	20.586 (3.924)	21.720 (3.296)	21.105 (3.203)	22.206 (3.013)	22.388 (2.891)	18.44	0.001
Self-identity	14.596 (4.441)	15.100 (5.345)	16.368 (3.730)	18.695 (4.242)	19.000 (3.680)	102.76	0.000
Subjective norm	13.323 (5.474)	14.600 (4.796)	13.895 (3.757)	15.394 (4.283)	15.732 (4.432)	18.28	0.001
Descriptive norm	9.636 (3.831)	10.280 (3.284)	10.263 (3.324)	11.218 (3.090)	11.118 (3.045)	15.87	0.001
PBC	11.566 (5.011)	14.200 (4.873)	14.222 (4.437)	16.539(4.381)	16.680 (4.216)	87.26	0.000

Note: All differences based on Kruskal–Wallis tests.

Table 3 Multiple Regression Analysis Predicting Behavioral Intention and Behavior

	Model 1			Model 2		
	β	t	R ²	β	t	R ²
Direct effect						
Behavior			0.374			0.404
Intention	0.441***	3.395	0.194	0.359**	2.896	0.129
PBC	0.135	0.943	–	0.057	0.452	–
Self-identity	–	–	–	0.236***	4.631	0.056
Descriptive norm	–	–	–	–0.023	–0.560	–
Age group	0.094*	2.383	0.009	0.100*	2.519	0.010
BMI	–0.087*	–2.735	0.008	–0.091*	–2.810	0.008
Intention			0.733			0.779
Attitude	–0.016	–0.354	–	–0.067	–1.822	–
Self-identity	–	–	–	0.261***	6.203	0.068
Subjective norm	0.009	0.278	–	0.000	0.010	–
Descriptive norm	–	–	–	0.035*	2.210	0.001
PBC	0.831***	20.058	0.691	0.683***	13.814	0.466
Age group	0.081*	2.139	0.007	0.081*	2.140	0.007
Stage of diet behavior	0.153***	4.150	0.023	0.153***	4.149	0.023
Indirect effect to behavior						
Attitude–intention	–0.007	–0.359		–0.024	–1.619	
Self-identity–intention	–	–		0.094*	2.555	
Subjective norm–intention	0.004	0.273		0.000	0.010	
Descriptive norm–intention	–	–		0.027	1.677	
PBC–intention	0.366***	3.443		0.245**	2.890	

Notes: All effects are standardized; *P<0.05; **P<0.01; ***P<0.001; only present significant relationships between control variables and TPB constructs. All models controlled all covariates.

extended TPB. Self-identity and descriptive norm were significant predictors of intention, and they contributed an additional 4.6% and 3.0% variance to the explanation of intention and behavior, respectively. Intention was the strongest predictor of exercise behavior. The effects of self-identity and PBC on exercise behavior were significantly mediated by intention. This study provided support for the usefulness of extended constructs of TPB and have strong implications for Chinese health promotion in patients with type 2 diabetes.

The results of the current study provide evidence for the utility of the TPB model in predicting stage of exercise in patients with type 2 diabetes. Within the traditional TPB, PBC significantly predicted intentions to exercise, but not for attitude and subjective norm. As shown in Table 3, most participants have higher attitudes toward exercise which may lead to lower heterogeneity between them; therefore, the effect of attitude on stage of exercise will be influenced. A literature review documented that attitude, subjective norms, and PBC could account for

45% variance of intention, and intention and PBC could explain 27% of variance in the exercise domain. Emerging research has applied the TPB to identify factors of physical activity among patients with type 2 diabetes. Another study in Australian patients found that intention could explain 28% of the variance in exercise behavior, attitude, subjective norm, and PBC could explain 73% of variance in intention.¹⁹ Subjective norm is also a weak predictor of intention, which has been found in many studies.^{20,21} In China, the health benefits of participating in sports have been widely recognized by people. Most of their relatives and friends hold supportive and encouraging attitude toward their exercise behavior, which may interfere with the effect size of the subjective norm.

Intention emerged as an important significant predictor of behavior, which was acknowledged by numerous physical activity studies.^{22,23} Besides, intention was found to mediate the relationship between self-identity and PBC and behavior. People who regard themselves as physically active were more likely to have higher intentions to exercise, and further advance the stage of exercise.⁵ It should be noted that our results did not find a significant relationship between PBC and behavior, which was not consistent with expectations, but not necessarily inconsistent with the TPB. Ajzen mentioned that PBC will influence actual behavior only if the behavior is not completely under the person's volitional control. Most patients were aware of the health benefits of exercise;⁶ they are unlikely to be influenced by external factors, in which case, exercise can be regarded as a relatively controllable behavior. In addition, individuals could overestimate their control over the behavioral performance in many cases.²⁴

The results of the current study also revealed that self-identity and descriptive norm were significant predictors of intention, and self-identity was also superior to subjective norm in predicting stage of behavior. Self-identity referred to the extent to which one person identified the target behavior as part of one's personality. The construct of self-identity has been widely adopted in the TPB and has a great ability in the prediction of intentions relating to exercise.⁵ People who considered themselves to have a strong exercise identity were both more likely to have a stronger exercise intention and also to engage in exercise.²⁵ Empirical evidence in the exercise domain corroborated our results.^{5,20}

This study also found that demographic and lifestyle factors may have an influence on the predictive ability of TPB. Age and BMI could directly influence the stage of

exercise. Older patients are more likely to start exercise, possibly because they have more leisure time and a relatively higher awareness of health protection.²⁶ Many individuals with higher BMI were more reluctant to start exercising as they have more comorbidities and physical impairments and report more unpleasant symptoms compared to their nonobese age peers.²⁷ Stage of diet behavior was significantly related to exercise intention. Physical activity was more linked to dietary behavior compared to other lifestyles. People who take their diet seriously were more likely to exercise.²⁸

These findings have important implications for tailoring and future intervention design in this population. First, increase intention to exercise. Community leaders and primary practitioners could hold lectures or social activities to promote the health benefits of exercise. Family and friends should help patients to increase their confidence to exercise. Second, the results of the study found that self-identity is an influential predictor of intention and behavior. Thus, encouraging patients to embrace an identity of being a physically active person would prove beneficial in promoting patients to start or continue a physical activity. Related authorities should improve infrastructure and provide sufficient sports equipment for people to use, which may help them to think of themselves as physically active unconsciously. Third, given the finding that descriptive norm predicted intention, family members could start to exercise themselves to set a role model for patients to follow.

Limitations of the present study are worth mentioning. First, this study involved a cross-sectional design which precluded the inference of causality. A second limitation is that the sample contained only a small number of participants in the preparation stage ($n=19$), which may have influenced the reliability of the findings concerning this stage.

Conclusion

This study has integrated the extended TPB into the stage of change to explain exercise in Chinese patients with type 2 diabetes. Self-identity and descriptive norm are strong predictors of exercise intention and could augment the predictive validity of the theory of planned behavior. Intention played the most important mediating role, which significant mediated the relationship between of self-identity and PBC and exercise behavior. The integration between extended TPB and stage of change is more theoretically comprehensive and sophisticated for understanding behavior change. Improving self-identity and

controllability of their exercise behavior would be a promising strategy to promote exercise in Chinese patients with type 2 diabetes.

Abbreviations

TPB, theory of planned behavior model; SOC, stage of change; PBC, perceived behavior control; χ^2/df , chi-square divided by degrees of freedom; RMSEA, root mean squared error of approximation; CFI, comparative fit index; TLI, Tucker-Lewis Index; WRMR, Weighted Root mean Square Residual.

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Author Contributions

Min Gao designed the study and wrote the article. All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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