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Understanding the Walk Intention of Older Adults in China with the Theory of Planned Behaviour and the Prototype Willingness Model

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ABSTRACT

Walking prevents disease and keeps older adults healthy. Studying the walking decision factors of ageing people is an imperative step in understanding and promoting their behaviour. The theory of planned behaviour (TPB) and the prototype willingness model (PWM) are two well-known frameworks that deal with reasoned and social reaction processes in decision-making. This paper used these frameworks to examine the motivational mechanisms of walking among older Chinese adults living in small towns and used the structural equation model (SEM) for regression analysis. The analysis was based on 407 questionnaires and compared two models. Model 1 is TPB and model 2 combines TPB with PWM. The results show that behaviour willingness (BW) is significantly correlated with behaviour intention (BI), and model 2 explains a higher proportion of intention variance than model 1. Perceived behavioural control (PBC) is the most significant predictor in the two models, which implies that walking usefulness and walking feasibility are critical to older adults' willingness to walk and walking program development. Finally, the utility of the integrative model is discussed, in terms of the theoretical contribution to walking among older adults and the applied implications for the promotion of walking.

KEYWORDS

older adults; walking intention; prototype willingness model; theory of planned behaviour.

1. INTRODUCTION

Under the trend of accelerated ageing of the socio-demographic structure, ensuring the well-being and health of older people is an essential way to promote social harmony and reduce the pressure on medical care. Walking, as a daily physical activity is a method to address older adults' mobility needs and improve their physical and mental health. Studies show that moderate physical activity, like walking, can effectively reduce the incidence of stroke, coronary heart disease and cancer in older adults [1, 2]. More mobility can reduce social isolation among older people [3]. However, although walking has numerous health benefits, the global trend of insufficient physical activity is becoming more evident. More than half of China's older adults fail to meet the WHO physical activity standards [4].

Effective interventions are needed to encourage walking and address declines in physical activity and health disparities among older adults. Several sociological and psychological theoretical frameworks have been studied to improve the effectiveness of behavioural interventions. The main objective of this study was to examine the utility of the TPB, and an integrated model incorporating TPB and PWM in the walking intentions of older adults.

1.1 The theory of planned behaviour

A social cognition theory that is commonly employed in behaviour analysis is the theory of planned behaviour (TPB). The TPB considers behavioural intention (BI) as a determinant predictor of behaviour, and intention indicates one's confidence and acceptance of the behaviour's implementation [5]. In the standard TPB, attitudes (ATT), subjective norms (SN) and perceived behavioural control (PBC) are considered factors influencing BI. ATT is used to describe the degree of individuals' approval or disapproval of the behaviour, SN indicates one's perception of how significant others approve of his/her behaviour and PBC represents the individual's perception of how useful and easy to perform the behaviour [6].

In most studies of physical activity by the TPB in older adults, ATT and PBC were significant predictors, indicating that older adults with more positive attitudes toward physical activity, less difficulty in performing physical activity, more control over physical activity and fewer events that impede physical activity are more likely to engage in physical activity [7–11]. In the TPB-based studies of walking in older adults, Lee mediated the TPB variances by outdoor surroundings in studies of walking in older adults, concluding that walking is associated with community safety and quality [12]. More recently, Liu added environmental variables (safety and comfort) and descriptive norms to the TPB model, in which comfort and descriptive norms directly and significantly affect the walking intention of older adults, indicating walking behaviour occurring around older adults was positively correlated with their intention to walk, and participants came from China's Nanjing, a highly developed city [13]. Although many studies were conducted on physical activity and walking among older adults, most focused on developed areas or large cities. For now, research has paid scant attention to walking among older adults in small towns.

Lots of studies included additional variables to the TPB to better understand older adults' behaviours and to obtain better explanations for intentions or behaviours, such as functional capacity [11], physical condition [14], autonomous motivation [10] and preliminary knowledge [15], and most of them refined the structural framework and increased the predictive power of older adults' intentions or behaviours. However, the TPB has still been criticised for only taking into account planned and intentional factors (ATT, SN and PBC) due to the limitations of the essence of TPB, that is, the ignorance of the influence of unintentional, improvised and unconsidered factors on intentions or behaviours [16].

1.2 The prototype willingness model

The PWM proposes a dual process to influence decision-making: the reasoned process and the social reaction process (*Figure 1*). The reasoned process (similar to the TPB) consists of ATT and SN, which affect intention, respectively. The social reaction process adds prototypes (including prototype favourability and prototype similarity) and behaviour willingness to predict intention [17]. Prototypes present a typical image of the target behaviour. Prototype favourability (PF) and prototype similarity (PS) respectively demonstrate how much they approve of the typical case and how much the individual is similar to the prototype. Many studies used PWM to analyse willingness and prototypes [18–21].

1.3 The integrative model

Many studies integrated elements of the TPB and the PWM to analyse intention and willingness [10, 12, 22]. Rivis et al. used the TPB+PWM variables to analyse the behaviour of older adults [23]. The results demonstrated a good ability of the model to explain the willingness of them to drive while intoxicated. For pedestrian behaviours, the TPB+PWM model had better utility than the TPB model in predicting pedestrian violations that Demir researched [21]. The utility of the model depends heavily on the target behaviour. In older adult walking, we consider that integration models may provide more accurate predictive power than standard TPB.

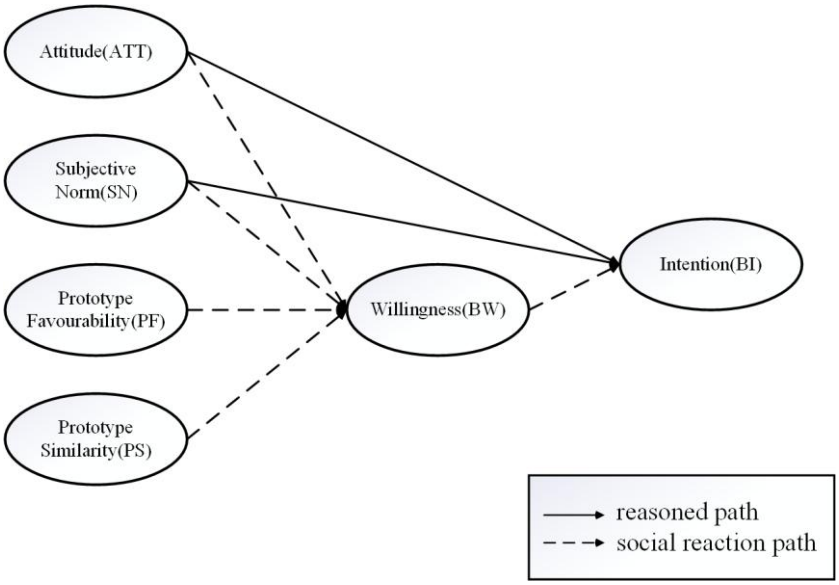

Figure 1 – The prototype willingness model (Adapted from Gibbons et al., 1998)

The walking behaviour of older adults is often characterised by unrestricted durations [24], as evidenced by the fact that older adults usually do not set specific departure and arrival times when they choose to travel on foot, unlike workers or students. According to Pu [25], Chinese older adults' short-distance trips were more concerned with money costs than time, which also suggested a weak perception of distance time in older adults. This weakened perception probably means that older people's walking intention is likely to be influenced by willingness. The decision-making process for walking in older adults may be triggered not only through the reasoned path included in the TPB but also through the social response path of the PWM.

1.4 The aim of this study

In summary, there is no theoretical framework for the analysis regarding the walking intentions of older adults in small towns. In addition, there is no exploration of unplanned factors. The purpose of this paper is to investigate the relationships among variables in two models, the TPB model and the integrative model (TPB+PWM) (*Figure 2*). We aim to explore whether the utility of the integrative model is accepted and the association of the variables with intention in older adults from small towns. To examine whether and, if so, how older adults' intention to walk is influenced by planned and unplanned factors.

The remainder of the paper below is composed of Section 2 Methods and data, Section 3 Models and results, Section 4 Implications, recommendations and future research, and Section 5 Conclusions.

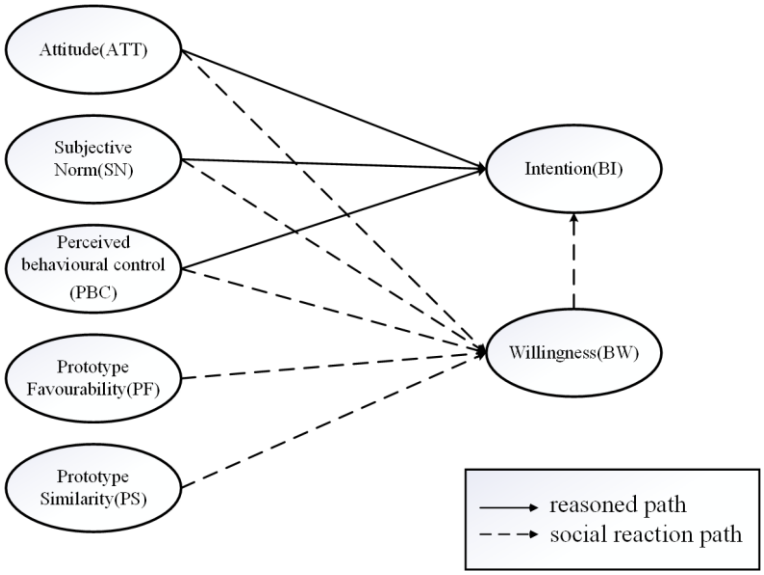

Figure 2 – Integrative model

2. METHODOLOGY

2.1 The structural equation model

This paper used a structural equation model (SEM), which is composed of two parts, measurement models and a structural model. Measurement models can explain the correlations between latent (dimension) variables and their corresponding indicator variables. The accuracy of the indicator variable representation for latent variables can be tested in a measurement model. The structural model represents the path relationships among latent variables, while the percentage of predicted degrees on the dependent variable can be obtained in a structural model. Initially, the samples are divided into two groups to prove that the measurement model is feasible by exploratory factor analysis (EFA) and confirmation factor analysis (CFA), then analysed. This study used Mplus software for the model analysis.

The following indices were selected to demonstrate model fitness: χ^2/Df, root mean squared error of approximation (RMSEA), standardised root mean squared residual (SRMR), comparative fit index (CFI) and Tucker-Lewis index (TLI).

2.2 Participants and data collection

The relevant document issued by the Chinese in 2000 defines small towns as "state-approved formed towns, including county (city) government towns and other formed towns". This paper adopts this concept and defines small towns as state-approved incorporated towns.

In terms of travelling characteristics, the spatial scale of small towns is limited, and the radius of residents' daily activities is small, basically forming a "20-minute living circle", and a single commuting trip of more than 30 minutes is considered unacceptable [26]. This spatial and temporal distribution makes it difficult to realise public transport as the main mode of transport in small towns, with non-motorised vehicles and slow-moving trips such as walking accounting for a large proportion of all-mode trips, usually more than 50 per cent.

Most small towns have fewer than 100,000 inhabitants. In terms of age structure, the largest number of people are 36–55 years old, followed by older people aged 55 years old or above, and the smallest number of residents are 35 years old or below, with the advancement of China's urbanisation process, the population structure of small towns will form an inverted pyramid type [27].

Regarding spatial characteristics and transportation, the space of small towns is dominated by satisfying basic living functions, with no obvious functional zoning, interpenetration of construction and non-construction land, highly mixed land use and low construction intensity. The road network planning of most small towns is still oriented to motorised vehicles, which makes the spacing of the road network in towns exceed the suitable spacing for walking. Most small towns do not have a systematic road network, and the road cross-section is basically in the form of a "one-panel", with the phenomenon of mixed traffic between motorised and non-motorised vehicles being more common.

The questionnaire was administered in 2021, and the options for the items were obtained from face-to-face conversations between investigators and small-town older adults in various locations. Participants were randomly selected to be interviewed from small towns in the Chinese provinces of Jiangsu, Anhui, Shanxi, Xinjiang, Gansu, Jilin and the Inner Mongolia Autonomous Region. The final 407 valid samples were selected for the study.

Table 1 describes the characteristics of the participants and demographic variables (e.g. age, education, retirement, economic situation, car use and electric bicycle use).

2.3 Measures

Due to the inability to measure directly, latent variables are described by items (indicator variables). Each latent variable in this paper is represented by four or five items. The questionnaire includes seven latent variables and thirty-two items. *Table 2* shows the meaning of each item and the correspondence between the items and the dimension variables. The items originating from the TPB dimension variables were modified based on the study by Frater et al. [13, 14, 20, 28, 29]. Compared to the study by Liu et al. we adjusted one item to include "I like walking a lot" in attitudes; added an item to include physicians' expectations of older adults in SN, and added "I have no trouble walking to the nearby wet market" in PBC because wet markets in small towns are one of the daily destinations for older adults.

The items of willingness, prototype favourability and prototype similarity were inspired by Gibbons et al. [17, 21, 30, 31]. In this paper, the authors describe an image of an older person who walks a lot, PF is used to measure how favourably the older person feels about this image, and PS is used to investigate how similar the older person feels to this image. Willingness is the tendency to behave in given scenarios. For example, if an older adult goes to a park 1 km away, the park is directly accessible by bus, how willing is he/she to walk there?

The above items were measured on a Likert 5-point scale (1 = "definitely disagree"; 5 = "definitely agree").

2.4 Control variables

Control variables have potential effects on the study results but are not in the interest of the study [32]. Control variables are typically derived from demographic variables. For example, the use of electric bikes indeed has an impact on older adults' walking intention, but it is not the focus variable in this paper. To reduce this effect, under the precondition that the model fitness index was satisfied, ownership of electric bicycle (ELE) and the frequency of electric bicycle use (ELEUSE) from *Table 1* were selected as control variables in this paper.

Table 1 – Participant characteristics (N=407)

	Percentage (%)	**Mean (SD)**
Age		69.79(7.11)
Education		
Illiteracy	18.09%	
Primary school	31.91%	
Middle school	40.86%	
College	9.15%	
Retire		
No	30.00%	
Yes	70.00%	
Economic situation		
Bad	8.72%	
Normal	39.79%	
Better	42.55%	
Good	8.94%	
Car ownership of the household		
No	46.17%	
Yes	53.83%	
How often do you drive		
Hardly ever	64.26%	
Occasionally	21.49%	
Usually	14.26%	
Electric bicycle ownership of the household		
No	40.85%	
Yes	59.15%	
How often do you ride electric bicycle		
Hardly ever	51.06%	
Occasionally	25.32%	
Usually	23.62%	

3. RESULTS

3.1 Measurement model

The questionnaire in this study utilised the classical scale and did not conduct the EFA process, only the CFA. The CFA is conducted separately on the latent variables and the results are presented in *Table 3*. Standardised factor loadings (Std. FL) are acceptable because they are all significant and more than 0.6 [33]. It is acceptable when the composite reliability (CR) of items loading on the dimension variable is greater than 0.7 [34]. The average variance extracted (AVE) is a measurement of the ratio of variation collected by a dimension variable to variance resulting from measurement error. An AVE greater than 0.5 is ideal, in the range of 0.36–0.5 is acceptable [35]. The CR values and AVE values in *Table 3* match the criteria. Therefore, the latent variables' convergent validity is acceptable.

Discriminant validity is the degree of difference between two latent variables, also known as Pearson correlation. This is used to distinguish between internal and external latent variables. The non-diagonal data from the right half of *Table 3* are Pearson correlation factors, and the data in bold (diagonal data) are the square root of AVE. The correlation factors between two latent variables are accepted if it is less than the square root of AVE [36]. The values of the almost diagonal data are greater than the Pearson correlation coefficients for the same row and column, indicating that the constructs have discriminant validity.

Table 2 – Items and dimension variables

Latent variables	Items	Code
ATT	The walking process is interesting	ATT1
	Walking reduces the risk of illness	ATT2
	I like walking a lot	ATT3
	The walking process is not boring	ATT4
SN	Family members and friends give me support to walk more	SN1
	Family members and friends motivated me to walk more	SN2
	The doctor encouraged me to walk more	SN3
	Family members and friends think walking is good for health	SN4
PBC	I have no trouble walking to the nearby wet market	PBC1
	I have no trouble walking to the nearby mall	PBC2
	I can climb 3 or 4 floors without any problem	PBC3
	I walked continuously for half an hour without any problems	PBC4
	I don't have any health problems if I take care of daily household chores	PBC5
PF	I think older people who walk frequently are very energetic	PF1
	I think older people who walk frequently are very self-confident	PF2
	I think older people who walk frequently are in good physical shape	PF3
	I think older people who walk frequently are very healthy	PF4
	I think older people who walk frequently are very independent	PF5
PS	I think I'm as attractive as the old people who walk frequently	PS1
	I think I'm as energetic as the old people who walk frequently	PS2
	I think I'm as self-confident as the old people who walk frequently	PS3

Latent variables	Items	Code
	I think I'm in good shape with those old people who walk frequently	PS4
	I think I'm as independent as the old people who walk frequently	PS5
BW	If you go to a park 1 km away, the park is directly accessible by bus. How willing are you to walk to?	BW1
	If you go to a supermarket 1 km away, the supermarket is directly accessible by bus. How willing are you to walk to?	BW2
	If you go to a friend's house 1 km away, the friend's house is directly accessible by bus. How willing are you to walk to?	BW3
	If you go to a restaurant 1 km away, the restaurant is directly accessible by bus. How willing are you to walk to?	BW4
BI	Starting next week, I plan on walking as much as possible when I go out	BI1
	I plan on walking more in future	BI2
	I will try to walk when I go to places that are not far away	BI3
	I strive to go out walking every day if there are no special circumstances	BI4
	In the future, I plan to walk when I go out to buy groceries	BI5

Table 3 – Convergent validity and discriminatory validity of dimension variables

Items	Std. FL	CR	AVE	ATT	SN	PBC	PF	PS	BI	BW
ATT	0.640—0.791	0.818	0.532	**0.730**						
SN	0.714—0.832	0.842	0.572	0.725	**0.756**					
PBC	0.677 – 0.825	0.860	0.552	0.492	0.711	**0.743**				
PF	0.655 – 0.783	0.844	0.521	0.677	0.563	0.502	**0.722**			
PS	0.678 – 0.807	0.859	0.550	0.592	0.638	0.688	0.715	**0.741**		
BI	0.696 – 0.753	0.836	0.505	0.657	0.701	0.715	0.637	0.708	**0.711**	
BW	0.689 – 0.841	0.862	0.610	0.498	0.584	0.610	0.404	0.550	0.628	**0.781**

3.2 Structural models

Structural model 1 – the TPB model

From *Table 4*, model 1 fits the data well and explains 63.5% of intentions variance. From *Table 5*, attitudes and PBC are significant predictors of intentions because the p-values on the corresponding paths are less than 0.05, and SN is not significant for intentions.

Structural model 2 – the TPB+PWM model

From *Table 4*, model 2 provides an appropriate fit to the data. For intentions, the model explains 70.4% of the variance. In addition, model 2 explains 46.1% of the variance for willingness. From *Figure 3*, only PBC is

a significant predictor of willingness. Willingness is significantly associated with intentions. The significant results of the other variables related to intentions are consistent with model 1.

Table 4 – Model fit and model explanation of variance

Index	χ^2/Df	CFI	TLI	RMSEA	SRMR	R^2(BI)	R^2(BW)
Standard value	1–3	>0.9	>0.9	<0.08	<0.08		
model 1 (*TPB*)	2.209	0.947	0.937	0.056	0.045	0.635	
model 2 (*TPB+PWM*)	2.271	0.910	0.901	0.056	0.050	0.704	0.461

4. DISCUSSION

4.1 The utility of models

In this paper, SEM is used to describe the path significance relationship among the latent variables in the two models separately for the walking intention of older adults. Model 1 is the standard TPB model. The latent variables are attitudes, SN, PBC and intentions. Model 2 (TPB+PWM) is based on model 1 with the addition of the prototype (PF and PS), willingness and their path causal associations (i.e. social reaction pathways).

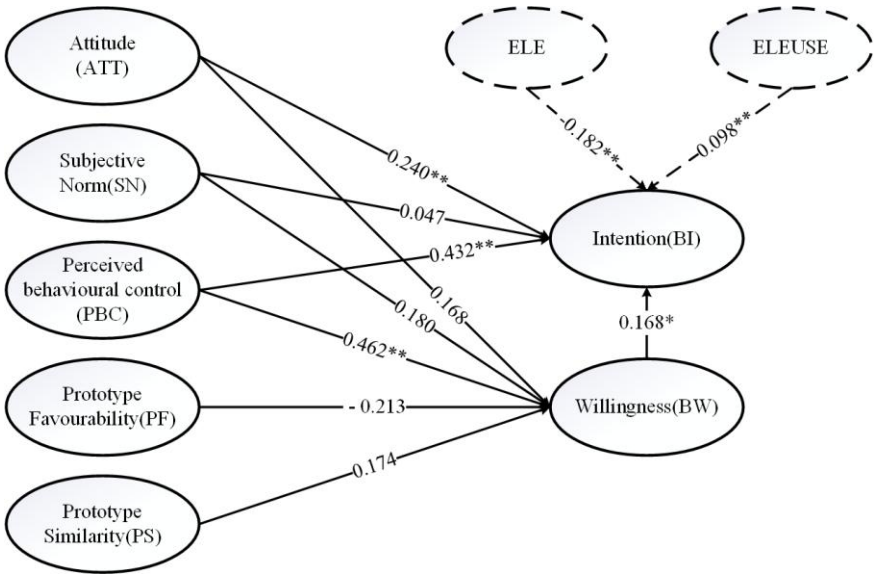

Figure 3 – TPB+PWM model. Dashed lines denote control variables
*(*p < 0.05, **p < 0.01. The dotted lines correspond to the control variables and their path relationships)*

In model 1, attitudes and PBC are significant predictors of intentions (*Table 5*), while SN is not associated with it. The results of the path relationship are similar to those of some studies based on the TPB [9, 13, 28, 29, 37]. PBC is the strongest predictor of intentions, and it is consistent with the outcome of most studies on physical activity and walking behaviour in older adults [8, 9, 11–14].

A more detailed description will be discussed around model 2. The addition of the PWM model variables increases model 2's ability to explain intentions variance by 6.9%. In other words, adding the variables of PWM to the TPB model increased the proportion of variance explained by the integration model for intentions, reflecting the better predictive power of the integration model. The results are consistent with the findings of Amanda and Paschal [18] in their study of health-risk behaviour. They found that adding PWM variables (prototypes and description norms) to the TPB increased the model's explanatory range for the intention to smoke, drink and eat junk food by 5% on average. Consistent with model 1, from *Table 5*, intentions in model 2 have the same significant latent predictor variables of the TPB (ATT and PBC). Furthermore, the significant correlation between PBC and willingness is consistent with the study of Zimmermann and Sieverding [38] on

adolescent social drinking behaviour, who obtained significant effects of self-efficacy on willingness for both boys' and girls' drinking behaviour analysis. PF and PS are not correlated with willingness, the results are contrary to those obtained by Demir [21] in the study of factors influencing pedestrian violation.

4.2 Implications

The current results support previous findings that attitudes and PBC correlate more strongly with intention than subjective norms. PBC is a valid predictor of willingness and intention, and individuals' willingness is enhanced when they believe they are capable of accomplishing a behaviour. This enhanced willingness is further transformed into explicit behavioural intentions.

Furthermore, the unexpected finding that prototype perceptions (similarity and favourability) are not related to willingness is not common in the literature. This may be because compared to younger people, older adults, with their stable self-identity, careful decision-making and stable social relationships, rely less on prototypes, and behavioural intentions are more driven by personal values and experiences.

Finally, to the best of the authors' knowledge, this study is the first attempt to use the TPB and PWM models to study walking behavioural decision-making processes. This study provides data to support that willingness is a valid predictor of intention. It may be because willingness takes into account an individual's reactivity and improvisational decision-making in a given situation, which makes people more inclined to transform their motivation into specific intentions, that is, explicit behavioural plans and goals.

Table 5 – Direct and indirect effects in path models

	BI			**BW**		
	DIRECT	**INDIRECT**	**TOTAL**	**DIRECT**	**INDIRECT**	**TOTAL**
TPB						
ELE	−0.134**		−0.134**			
ELEUSE	0.113*		0.113*			
ATT	0.318**		0.318**			
SN	0.119		0.119			
PBC	0.470**		0.470**			
Integrative M. (TPB +PWM)						
ELE	−0.182**		−0.182**	0.145		0.145
ELEUSE	0.098**		0.098**	−0.010		−0.010
ATT	0.240**	0.028	0.269**	0.168		0.168
SN	0.047	0.030	0.077	0.180		0.180
PBC	0.432**	0.078*	0.318**	0.462**		0.462**
PF		−0.036	−0.036	−0.213		−0.213
PS		0.029	0.029	0.174		0.174
BW	0.168*		0.168*			

*N = 407, *p < 0.05, **p < 0.01.*

Walking has shown many positive aspects for older adults, both in terms of transportation and public health care. As small towns in China are moving towards urbanisation with a steady trend, all aspects of elderly people's lives are changing. Many elderly people's adaptability cannot keep pace with development in their places of residence. This paper proposes effective interventions for planners and designers to address the problems of difficult walking, low percentage of walking trips, and insufficient physical activity levels for the older population in small town areas. Based on changing trends in small-town populations, the authors give recommendations for both facilities and planning to enhance walking behavioural control for older adults. The facilities aim to achieve the goal of barrier-free infrastructure to allow older adults to engage in a continuous environment by (1) implementing zero height difference design on road sections: i.e. both pedestrian and vehicular road surfaces are articulated with zero height difference and separated by protective stakes to avoid safety issues, and (2) installing non-slip paving at important locations such as intersections to allow the older adults to have safe walking experience even in the rain. Likewise, continuous unobstructed wide-enough sidewalks, seating on sidewalks, and more volunteers on the road will make walking more likely for seniors who consider walking is out of control.

Based on typical cases at home and abroad, such as "Summer Streets" in New York and Beijing's policy of limiting the number of motor vehicles, the authors' suggestion for transportation planning is to consider the timed street. That is in the specified time of the specified streets, only public transportation and slow traffic are allowed to pass, and further can also implement all-time motor vehicle control of pedestrian streets, prohibit motor vehicles, and eliminate sidewalks and road parking. Eventually combined with local history and culture to connect such streets to become characteristic walking tour routes. Meanwhile, the authorities can conduct exhibitions, activities and fellowships regularly to promote walking in pedestrian areas and routes.

4.3 Further research

This paper is a study with older adults walking intention as the dependent variable and does not address walking behaviour. The extended theoretical framework should be applied to actual behaviour in future studies. In addition, SN was found not to be a significant predictor of behaviour, which is consistent with previous studies [39, 40]. Future studies may include other social norm variables as a complement, such as descriptive norms [41] and personal norms [42].

In this research, a positive significant pathway of PBC to intention via willingness was investigated. On this basis, we proposed recommendations for PBC to enhance older adults' walking intentions. However, recommendations for willingness were not proposed, because a simple path relationship and mediating effects for willingness were only revealed in this paper. Future research could look more closely at the factors associated with how willingness affects walking in older adults.

We analysed the behaviour of older people in the areas of small towns. Much of the past research on older adults' walking intentions and behaviours focused on older adults in urban areas [12, 13]. Siren and Hakamies-Blomqvist [43] suggested that older adults in high-density areas walk more than those in low-density areas. Future research could combine participants from small towns with those from well-developed metropolitan areas and rural areas in the same model to perform a deeper comparative analysis of paths and variables.

5. CONCLUSION

This paper compared the prediction ability of the TPB model and TPB+PWM model for the walking intention of the elderly based on the method of structural equation modelling. To sum up, we concluded that the integration model, which includes willingness variables and prototype variables, is an optimised structural framework for analysing walking intentions among older people in Chinese towns. In the case of older adults walking, the integrated model explains both the long-term planned and short-term context-driven nature of intentions. This optimisation process is achieved from small-town older people's perceived control of walking behaviour. Increasing the self-efficacy and behavioural control of older adults in walking requires site-specific efforts in both planning and facility development.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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摘要:
步行可以预防疾病，保持老年人的健康。研究老年人的步行决策因素是了解和促进其行为的必要步骤。计划行为理论（Theory of Planned Behavior，TPB）和原型意愿模型（prototype Willingness Model，PWM）是两个著名的框架，涉及决策中的理性和社会反应过程。本文利用这两个框架研究了居住在小城镇的中国老年人步行的动机机制，并使用结构方程模型（SEM）进行了回归分析。分析以 407 份问卷为基础，比较了两个模型。模型 1 是 TPB，模型 2 结合了 TPB 和 PWM。结果显示，行为意愿（BW）与行为意向（BI）显著相关，与模型 1 相比，模型 2 解释了更高比例的意向变异。感知行为控制（PBC）是两个模型中最重要的预测因素，这意味着步行的实用性和步行的可行性对老年人的步行意愿和步行计划的发展至关重要。最后，从对老年人步行的理论贡献和推广步行的应用意义两方面讨论了综合模型的实用性。