

Factors Associated with Physical Activity in Elderly Nursing Home Residents: A Path Analysis

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Abstract

Background: Physical activity (PA) is low among elderly residents in nursing homes in China. We aimed to determine the factors that influence PA among elderly nursing home residents and their direct or indirect effects on PA levels.

Methods: The PA levels of the participants were measured using the International Physical Activity Questionnaire, and their health beliefs were assessed using a self-developed 18-item questionnaire titled the 'Health Beliefs of Nursing Home Residents Regarding Physical Activity,' in accordance with Health Belief Model (HBM) constructs. The correlations between HBM constructs and PA levels were analyzed and a regression-based path analysis was conducted to examine the relationships between HBM constructs and PA levels.

Results: A total of 180 residents with a mean age of 82.5 years (standard deviation = 5.76) were recruited. Linear regression analysis revealed that self-efficacy ($p < 0.001$), perceived severity ($p < 0.01$), and cues to action ($p < 0.01$) were associated with the level of PA among nursing home residents. In the conceptual path model, self-efficacy, perceived severity, and cues to action had positive direct effects on PA level, while perceived benefits and perceived barriers had indirect effects on the PA level.

Conclusion: The residents' self-efficacy, perceived severity, and cues to action were found to be important factors that can affect the design and implementation of educational programs for PA. A better understanding of such associations may help healthcare providers design informed educational interventions to increase PA levels among nursing home residents.

Background

Poor physical activity (PA) was reported to be the fourth leading risk factor for non-communicable diseases. Poor PA leads to insufficient energy expenditure, which results in obesity and chronic diseases like type 2 diabetes and cardiovascular diseases [1]. PA is essential for healthy aging and offers many health benefits, including reduced risk of chronic diseases [2] and premature death [3]. Moreover, the implementation of a PA program improves physical [4] and cognitive functions [5, 6], increases the quality of life, and decreases depressive symptoms [7] in elderly adults.

PA recommendations for elderly adults are a minimum of 150 minutes of moderate-intensity aerobic PA or at least 75 minutes of vigorous-intensity aerobic PA or an equivalent combination of both throughout the week [8]. However, elderly adults are more likely to be introverted, physically inactive, and reluctant to join social activities [7]. This situation is more evident in nursing home residents, which is partly attributed to the limited space, fewer exercise coaches, and reduced physical function.

The commonly used approach to explain PA is the Health Belief Model in Physical Activity (HBMPA) [9]. Concepts from the HBM are widely used to explain individual psychological factors associated with PA.

HBM is one of the most important theoretical frameworks and has been shown to be useful in understanding and explaining preventive behaviors. As one of the most widely used psychological theories of health behavior, HBM is comprehensive for both psychological readiness and normative or environmental factors that influence health behavior, including six constructs: personal susceptibility and severity, efficacy, cues to action, physical, psychological, and financial barriers, benefits, and costs [10, 11]. It provides a means to understand the attitude, behaviors, and educational needs of people. Regular PA or exercise can be best explained by HBM for individuals in both healthy and chronic states. A previous study [12] indicated that there was a positive correlation between perceived benefits and PA, but an inverse correlation between perceived barriers and PA. A strong sense of accomplishment and enjoyment as well as the enhancement of physical performance are positive benefits for older adults taking part in a new PA program [13]. Crombie et al [14] identified pain (related to an existing condition), lack of interest, and facility accessibility as perceived barriers to daily activity for older adults. However, to date, few studies have assessed the PA level of elderly nursing home residents based on HBM constructs and associated factors.

Therefore, we aimed to explore factors associated with PA level among elderly nursing home residents using the HBMPA. We examined whether PA is associated with HBM constructs in elderly nursing home residents and developed a path model to demonstrate how these constructs were correlated.

Methods

Study design

This is a cross-sectional study conducted from June 3rd to August 30th 2019 in Taikang Community, Xiaocixuan Nursing Home, and Shiqi Nursing Home in Guangdong Province. The institutional board review was approved by the First Affiliated Hospital of Guangdong Pharmaceutical University and all participants provided informed written consent.

Participants

We included participants who 1) lived in the nursing home for over 3 months, 2) reported no difficulty in walking or were currently using a walking stick, 3) and showed no evidence of psychiatric conditions or difficulty in communicating.

Measures

Based on the domains of The Ecological Model of Active Living in a previous study [9], the contents of the questionnaire included the following: sociodemographic characteristics and health status, PA level, and the self-developed instrument named the Health Beliefs of Nursing Home Residents Regarding Physical Activity.

Sociodemographic characteristics and health status

Sociodemographic information including age, gender, marital status, education level, smoking status, alcohol consumption, weight, height, and diagnosis of chronic disease were collected. Self-reported medical conditions and duration of illness were confirmed by treatment and/or medication.

Physical Activity Assessment

The total PA level over the past 7 days was measured using the International Physical Activity Questionnaire (IPAQ) [15]. The reliability and validity of the questionnaire among Chinese older adults were confirmed by Deng et al. in 2007 [16]. PA at different levels of intensity was assessed and any activity with a duration <10 min was eliminated. The total duration of PA was measured in minutes and converted to metabolic equivalent scores ($\text{MET} \cdot \text{min} \cdot \text{wk}^{-1}$) for each type of activity. The MET score weights each type of activity by its energy expenditure, with 8 METs for vigorous activity, 4 METs for moderate activity, 3.3 METs for walking, and 1 MET for sitting.

Health Beliefs of Nursing Home Residents Regarding Physical Activity

The instrument was designed based on the HBM, focusing on the health beliefs of elderly nursing home residents regarding PA. Six major concepts of HBM (perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy) were adopted while designing the questionnaire. All parts of the HBM measurement were scored based on a 5-point Likert scale, ranging from 1 for 'strongly disagree' to 5 for 'strongly agree'. The questionnaire originally comprised 21 items regarding the beliefs of elderly nursing home residents about PA. The psychometric properties of this instrument will be tested in this paper before commencement of the path analysis. Participants either self-administered the questionnaire or received assistance from research assistants.

Data analysis

The sample size for performing a planned path analysis was estimated. A sample size of 5 to 10 per item was needed to achieve a clear factor structure. Therefore, the desired minimum required sample size was determined to be 180.

Descriptive statistics were presented as frequency (percentage) or mean (standard deviation) as appropriate. Continuous variables were analyzed by one-way analysis of variance (ANOVA) and Student's t-test, and categorical variables were analyzed by the chi-square or Fisher's exact tests as appropriate. Spearman correlation coefficient tests were conducted to test the associations between the HBM constructs, PA level, and sedentary time. Multiple linear regression analysis was used to examine the factors associated with the PA level. The results were considered statistically significant at $p < 0.05$. All above analyses were performed using the Statistical Package for Social Sciences (SPSS, version 21.0).

Validity and Reliability of the Health Beliefs of Nursing Home Residents Regarding Physical Activity

Structural validity was examined using confirmatory factor analysis (CFA). Model fit was evaluated using multiple fit indices in CFA. The common fit indices chosen were: normed chi-square (χ^2/df), comparative

fit index (CFI), and root mean square error of approximation (RMSEA). A good model fit was defined as: $\chi^2/df < 2$, CFI > 0.90, and RMSEA < 0.06, while an acceptable model fit was defined as: $\chi^2/df < 3$, CFI = 0.80-0.89, and RMSEA < 0.10 [17].

To determine the internal consistency of the instrument, the Cronbach's alpha coefficient was evaluated. A threshold of 0.7 was considered acceptable while 0.6 was considered reasonable [18].

Path Analysis

To investigate the relationship between the PA level, health beliefs, and sociodemographic characteristics, a path analysis model was developed and tested using Amos 22.0. The path analysis was used to explore the direct or indirect dependencies among a set of variables including demographics and health belief model characteristics. The goodness of fit of the final model was assessed with the chi-square test and the goodness of fit indices, such as RMSEA, standardized root mean square residual (SRMR), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normed fit index (NFI), incremental fit index (IFI), Tucker-Lewis index (TLI), and CFI. The values for GFI, AGFI, NFI, IFI, TLI, and CFI range from 0 to 1, with values greater than 0.90 indicating a good fit. Conventionally, there is a good fit if the RMSEA and SRMR are less than 0.05.

Results

A total of 180 individuals aged 60 and above were approached and the response rate was 100%. The participants' sociodemographic characteristics are described in Table 1. Among the 180 participants, the median age was 82.5 (range, 61-95). In our study, participants that were less educated, unmarried, or diabetic and those with limited mobility tended to engage in a lower level of PA. The median PA was 25.7 minutes/day (range, 0-180) and 884.5 MET minutes/week (range, 0-6375). The prevalence of physical inactivity was common among elderly adults in the nursing home, 50% of whom performed < 600 MET minutes/week of PA and over 90.0% (163 participants) of whom reported low-intensity exercise such as walking. Participants engaging in > 600 MET minute/week of PA were more likely to be well educated (37.8%), have no chronic conditions, and score higher in the subscales for perceived severity and perceived benefits.

Validity and Reliability of the Health Beliefs of Nursing Home Residents Regarding Physical Activity

The Health Beliefs of Nursing Home Residents regarding Physical Activity was found to be valid and reliable. Confirmatory factor analysis was used to test the structural validity. The fit indices for the 18 items-model were $\chi^2/df=2.287$, CFI=0.893, and RMSEA=0.085, indicating an acceptable fit to the data.

The Cronbach's alpha coefficient for each section, namely "perceived susceptibility", "perceived severity", "perceived benefits", "perceived barriers", "cues to actions", and "self-efficacy", was 0.790, 0.665, 0.751, 0.764, 0.696, and 0.865, respectively.

Correlation analysis and multiple linear regression analyses

As shown in Table 2, we found statistically significant correlations between all of the HBM variables and PA levels (p all < 0.01). The range of the r coefficient was from 0.307 (for the relationship between perceived susceptibility and PA level) to 0.635 (for the relationship between self-efficacy and PA level).

The multiple linear regression results are shown in Table 3. Only three of the HBM constructs (self-efficacy, perceived severity, and cues to action) were found to positively affect the PA level. Specifically, self-efficacy showed the strongest positive relationship with total PA level.

Path analysis

Based on the results of the linear regression model, we established a path analysis model to explore the relationship between HBM constructs and daily PA. There were four hypotheses in the model: (i) that 'self-efficacy' had a direct effect on total PA (0.52); (ii) that 'perceived severity' had a direct effect on total PA (0.14); (iii) that 'cues to action' had a direct effect on total PA (0.18); and (iv) that 'self-efficacy' played a mediating role between 'perceived benefits' and 'perceived barriers' and total PA. As shown in Figure 1, the fit indices were satisfactory for this model ($\chi^2=5.664$, $\chi^2/df=1.129$, $p=0.342$, RMSEA=0.027, SRMR=0.022, GFI=0.991, AGFI=0.950, CFI=0.998, NFI=0.986, IFI=0.998, TLI=0.993).

Discussion

Our study found that half of nursing home participants did not meet the current PA recommendations [19], performing PA less than 600 MET min/wk, mostly with low-intensity PA. This was consistent with the findings by Mary et al. [20] that lower intensity and less PA were common among older adults in China. We conducted path analyses and found three factors associated with PA. This is the first study that attempted to understand the factors associated with PA in a nursing home population in China.

We identified three variables (perceived severity, cues to action, and self-efficacy) in the path analysis that were the strongest predictors for the residents' PA levels, suggesting that variations in perceived severity, cues to action, and self-efficacy can be expected to alter PA engagement by about 57%. This was similar to the findings from Fatemeh [21] that the perceived severity of cardiovascular disease could affect PA behavior more than any other factor. Furthermore, we found that perceived barriers and benefits have indirect effects on the PA level, with self-efficacy serving as the mediating factor. A previous qualitative study based on the HBM framework [22] revealed that older adults performed PA for health and recreation, whereas emotions and social support limited their confidence in behavior perception. In general, behavior depends on self-efficacy, which is one of the clearest correlates in adults with preventive health behaviors and refers to confidence in their ability to be physically active in particular situations [23]. The maintenance of healthy behaviors is one of the main challenges in health education and promotion. With higher confidence and the appropriate skills, individuals develop the self-efficacy to adhere to a planned exercise routine [24]. Additionally, the motivation for PA can be influenced by

emphasizing the perceived benefits of PA such as healthy aging, positive health benefits for cardiovascular protection, physical function, and weight loss.

Regarding the implications for clinical practice, the overall aim of healthcare services for older adults living in a nursing home is to optimize their health, well-being, and quality of life, to achieve the main goal of active living. Based on our findings, elderly residents in the nursing home were generally not inclined to a sedentary lifestyle if they associated physically active behaviors with health. Moreover, proper educational programs for PA engagement interventions, adequate facilities, and personnel for exercise guidance for nursing home residents are needed. Previous studies conducted in China showed that vigorous PA, compared with low and moderate PA, was associated with a lower risk of stroke in elderly people [2]. Findings from Underwood et al. [25] also suggested that a moderate-intensity exercise program did not reduce depressive symptoms among residents of care homes. Increasing PA might be beneficial and contribute to various health benefits and decreased risks of diseases. However, due to the high prevalence of dementia among nursing home residents [6], preventive measures are necessary when implementing a PA program. Moreover, the optimal choice of a PA for nursing home residents is largely limited by specific risks, such as physical integrity and weakening [26].

Our study has some limitations. First, HBM constructs focus on a limited number of factors and ignore cultural, social, and economic factors and the previous experiences of elderly residents. They may also lack predictability compared to other empirical studies [27]. However, retrieving sociodemographic factors from participants is difficult. In our study, we used a questionnaire to take into consideration several factors including educational background, marital status, smoking and drinking status, diagnosis of chronic diseases, and mobility capability. Second, our study was conducted in a relatively niche group of elderly individuals in a nursing home setting, which may limit its generalizability. However, this study will provide fundamental data on how to improve PA in this population of patients.

Conclusions

In conclusion, we found that perceived severity, cues to action, and self-efficacy were associated with PA. HBM was found to be helpful in understanding the direct and indirect associations of cognitive determinants with the PA level among these individuals. This study provides evidence on the useful factors for intervention to improve PA among elderly adults in nursing homes.

Abbreviations

PA: Physical activity

HBM: Health belief model

Declarations

Ethics approval and consent to participate: This study was approved by the institutional review board's medical ethics committee at the First Affiliated Hospital of Guangdong Pharmaceutical University. Written informed consent was obtained from nursing home residents.

Consent for publication: Written informed consent was obtained from nursing home residents for publication.

Availability of data and materials: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Tables

Table 1 Descriptive characteristics of participants stratified by physical activity (N = 180)

Characteristic	PA level (MET min/wk)			F/t/ χ^2	P	
	Total (N=180)	<600 (N=90)	\geq 600 (N=90)			
Age, Mean (SD), y	82.46 \pm 5.76	82.93 \pm 6.50	82.0 \pm 4.90	1.101	0.272	
Sex, n,%	Men	60 (33.3)	26 (28.9)	34 (37.8)	-1.261	0.207
	Woman	120 (66.7)	64 (71.1)	56 (62.2)		
Education level, n %				-3.363	0.001	
	Illiterate	59 (32.8)	36 (40.0)	23 (25.6)		
	Elementary school	40 (22.2)	23 (25.6)	17 (18.9)		
	Junior High school	16 (8.9)	12 (13.3)	4 (4.4)		
	Senior High school	17 (9.4)	5 (5.6)	12 (13.3)		
	High Education	48 (26.7)	14 (15.6)	34 (37.8)		
Marital status, n %				-2.174	0.030	
	Married	64 (35.6)	25 (27.8)	39 (43.3)		
	Unmarried	116 (64.4)	65 (72.2)	51 (56.7)		
Height, Mean (SD), m	1.56 \pm 0.09	1.54 \pm 0.08	1.57 \pm 0.09	-1.708	0.089	
Weight, Mean (SD), kg	57.81 \pm 9.29	57.60 \pm 9.90	58.0 \pm 8.73	-0.299	0.765	

3MI, kg/m ²					-0.439	0.661
	<18.5	3 (1.67)	2 (2.2)	1 (1.1)		
	18.5-23.9	98 (54.4)	47 (52.2)	51 (56.7)		
	24.0-27.9	65 (36.1)	33 (36.7)	32 (35.6)		
	≥28.0	14 (7.8)	8 (8.9)	6 (6.7)		
Hypertension, n, %					3.733	0.053
	Yes	124 (68.9)	68 (75.6)	56 (62.2)		
	No	56 (31.1)	22 (24.4)	34 (37.8)		
CHD, n, %					0.378	0.539
	Yes	68 (37.8)	32 (35.6)	36 (40.0)		
	No	112 (62.2)	58 (64.4)	54 (60.0)		
Stroke, n, %					2.883	0.090
	Yes	19 (10.6)	13 (14.4)	6 (6.7)		
	No	161 (89.4)	77 (85.6)	84 (93.3)		
Diabetes, n, %					4.091	0.043
	Yes	132 (73.3)	72 (80.0)	60 (66.7)		
	No	48 (26.7)	18 (20.0)	30 (33.3)		
Cancer, n, %					0.000	1
	Yes	2 (1.1)	1 (1.1)	1 (1.1)		
	No	178 (98.9)	89 (98.9)	89 (98.9)		
COPD, n, %					0.000	1
	Yes	1 (0.6)	1 (1.1)	0		
	No	179 (99.4)	89 (98.9)	90 (100.0)		
Other diagnosed diseases, n, %					1.471	0.225
	Yes	19 (10.6)	12 (13.3)	7 (7.8)		

	No	161 (89.4)	78 (86.7)	83 (92.2)		
Limitation of mobility, n, %					8.229	0.004
	Yes	40 (22.2)	28 (31.1)	12 (13.3)		
	No	140 (77.8)	62 (68.9)	78 (86.7)		
Complication, n, %					0.000	1.000
	Yes	8 (4.4)	4 (4.4)	4 (4.4)		
	No	172 (95.6)	86 (95.6)	86 (95.6)		
Number of diagnosed diseases, Mean (SD)		1.58±1.06	1.62±1.09	1.54±1.04	0.49	0.624
Duration of diagnosed disease, Mean (SD), years		12.7±9.67	12.35±8.88	13.04±10.43	-0.483	0.629
Smoking status, n, %					0.424	0.515
	Yes	10 (5.6)	6 (6.7)	4 (4.4)		
	No	170 (94.4)	84 (93.3)	86 (95.6)		
Drinking status, n, %					0.719	0.396
	Yes	26 (14.4)	11 (12.2)	15 (16.7)		
	No	154 (85.6)	79 (87.8)	75 (83.3)		
Sedentary time, Mean (SD), minute		428.17±153.06	524±135.75	332.33±100.58	10.762	0.001
Health Belief Model, Mean (SD)						
	Perceived susceptibility	7.29±2.15	6.74±2.01	7.84±2.16	-3.541	0.001

Perceived severity	8.35±1.52	7.83±1.53	8.85±1.34	-4.766	0.001
Perceived benefits	8.24±1.41	7.74±1.42	8.73±1.22	-5.038	0.001
Perceived barriers	6.29±2.20	7.04±1.77	5.53±2.34	4.889	0.001
Cues to action	6.37±1.90	5.7±1.77	7.03±1.80	-4.998	0.001
Self-efficacy	5.89±2.52	4.36±2.06	7.42±1.96	-10.208	0.001

Abbreviation: physical activity (PA), body mass index (BMI), metabolic equivalent (MET), coronary heart disease (CHD), chronic obstructive pulmonary disease (COPD).

Table 2 Correlations between HBM constructs, physical activity level, and sedentary time (N=180)

Item	Mean±SD	PA level		Sedentary Time	
		r	P	r	P
Perceived susceptibility	7.29±2.15	0.307	0.01	-0.323	<0.001
Perceived severity	8.35±1.52	0.347	0.01	-0.346	<0.001
Perceived benefits	8.24±1.41	0.387	0.01	-0.414	<0.001
Perceived barriers	6.29±2.20	-0.470	0.01	0.548	<0.001
Cues to action	6.37±1.90	0.387	0.01	-0.403	<0.001
Self-efficacy	5.89±2.52	0.635	0.01	-0.649	<0.001

Table 3 Multiple Regression Analysis for factors predicting physical activity level in elderly adults in nursing home

Variable	<i>B</i>	Standard error	β	<i>t</i>	<i>P</i>
Constant	-391.542	73.805		-5.305	0.001
Self-efficacy	50.075	5.306	0.549	9.438	0.001
Perceived severity	25.972	8.921	0.172	2.911	0.01
Cues to action	19.422	7.35	0.16	2.642	0.01

Figures

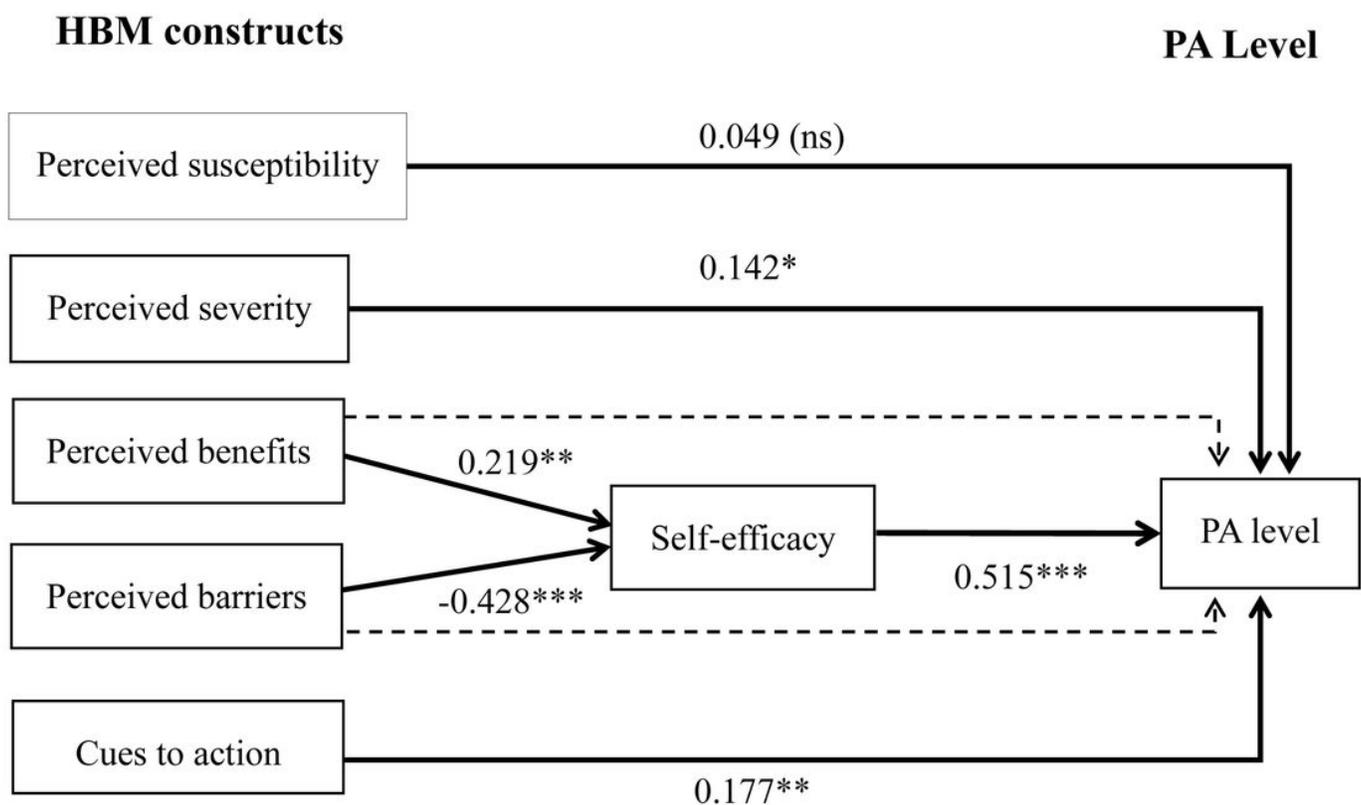


Figure 1

Path Model for Effects of HBM Constructs on PA level, Direct effects are represented by solid arrows; indirect effects are represented by dotted arrows. The β values are shown beside each arrow. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$; ns, not significant. Abbreviations: Health belief model (HBM), physical activity (PA)