

Oral Health Service Utilization Behavior and Its Influencing Factors Among Older Adults: An Empirical Study Based on the Composite Health Behavior Model

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Abstract

Background

China's aging population faces significant unmet oral healthcare needs, and delays in seeking care exacerbate the disease burden. Currently, there is a lack of empirical research applying comprehensive health behavior models to understand the pathway relationships among influencing factors in this population.

Methods

A cross-sectional study was conducted between July and September 2023 among 356 community-dwelling older adults in Foshan and Guangzhou, using a theory-driven questionnaire. Group comparisons employed independent t-tests or ANOVA for sociodemographic variables. Structural equation modeling (SEM) validated pathways.

Results

Significant differences were observed: 1) Sex and age affected individual model variables; 2) Education, residence location, and economic status influenced multiple variables; 3) Living arrangement showed no significant effects. Only 33.7% of older adults proactively sought oral health knowledge, while 65.7% did not receive regular dental check-ups. Merely 51.2% sought treatments (e.g., scaling, fillings, extractions, dentures, implants). When acute oral pain disrupted daily life, 24.7% still delayed seeking care. SEM revealed: 1) Behavioral Intention/Control had the strongest total effect on utilization behavior ($\beta = 0.593$); 2) This was followed by Perceived Benefits ($\beta = 0.404$); 3) Subjective Norms exerted only indirect effects ($\beta = 0.216$); 4) Both Subjective Norms ($\beta = 0.365$) and Perceived Benefits ($\beta = 0.282$) directly influenced Behavioral Intention/Control.

Conclusion

Oral health service utilization among older adults in China remains largely passive. Our model identifies three key modifiable factors: Behavioral Intention/Control, Perceived Benefits, and Subjective Norms. Strategies to improve service utilization should focus on strengthening social support and addressing unrealistic health perceptions.

Introduction

Oral health service utilization is defined as "the actual amount of dental services received by residents, reflecting both service provision and institutional efficiency" ¹. Regular utilization enables early detection and management of oral diseases through preventive care, effectively maintaining oral health while reducing long-term treatment frequency and costs. As China's population rapidly ages—with adults aged ≥ 60 years increasing by 5.44% from 2010 to 2020 and reaching 264.02 million (18.7% of the population) in 2020 ²—older adults face disproportionately poor oral health. The Fourth National Oral Health Survey revealed alarming statistics among those aged 65–74: 98% had Decayed/Missing/Filled Teeth (DMFT), 90.3% exhibited dental calculus, and only 9.3% maintained periodontal health ³. This underscores an urgent need to address oral health disparities in China's aging population.

These findings indicate suboptimal oral health behaviors among older adults in China, where behavioral factors constitute critical modifiable targets for intervention. The determinants of elderly health behavior are multifaceted, yet empirical applications of established behavioral theories (e.g., HBM, TPB) remain limited in oral health research within China's context ⁴. Existing studies predominantly focus on clinical outcomes rather than comprehensively exploring psychosocial determinants, resulting in insufficient theoretical foundations for evidence-based interventions ⁵. Behavioral theories transcend mere categorization of health habits; they provide mechanistic frameworks for designing targeted interventions across individual, community, and policy levels ⁶. As emphasized by the UK National Institute for Health and Care Excellence (NICE), "theory-based behavior change interventions demonstrate greater efficacy than atheoretical approaches" ⁷. Globally, preventive dentistry increasingly employs behavioral theories to enhance self-care and treatment adherence, evidenced by the 11th European Workshop on Periodontology recommending psychological methods for plaque control in periodontal management ⁸. Consequently, theoretically grounded identification of influencing factors and pathways represents the vanguard of oral health interventions ⁹.

Among behavioral frameworks, the Health Belief Model (HBM) and Theory of Planned Behavior (TPB) are most established. This study therefore integrates HBM and TPB to develop a composite model specific to elderly oral health service utilization, aiming to elucidate behavioral mechanisms and inform targeted interventions.

Materials and Methods

2.1 Theoretical Framework and Composite Model Construction

2.1.1 Health Belief Model (HBM)

The core of the Health Belief Model (HBM) is perception, which refers to the perception of disease threat and the evaluation of behaviors. This encompasses: Perceived Susceptibility, Perceived Severity, Perceived Benefits, and Perceived Barriers. Subsequent scholars have further developed two additional core components: Self-Efficacy and Cues to Action. Self-efficacy represents the assessment of one's ability to successfully adopt a health behavior, while cues to

action are stimuli that prompt the initiation of action, such as noticing gum swelling, pain, or bleeding¹⁰. A schematic diagram of the Health Belief Model is shown in Fig. 1.

2.1.2 Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) comprises five main components: Attitude toward the Behavior, Subjective Norm, Perceived Behavioral Control, Behavioral Intention, and Behavior¹¹. TPB posits that behavior is determined by behavioral intention. Behavioral intention, in turn, is influenced by three factors: attitude toward the behavior, subjective norm, and perceived behavioral control. A schematic diagram of the Theory of Planned Behavior is shown in Fig. 2.

Note The dashed line signifies that accurate perceived behavioral control can serve as a valid proxy measure for actual control conditions, enabling direct prediction of the likelihood of behavior occurrence

2.1.3 Integrated Model Development

The contents of the HBM and TPB are closely interrelated. Therefore, during the integration process in this study, similar dimensions were streamlined. In the TPB, Attitude toward the Behavior can be divided into positive and negative attitudes. Conversely, the HBM includes Perceived Benefits and Perceived Barriers, which correspond to positive and negative attitudes, respectively, in terms of cost-benefit analysis¹². Consequently, in this study's integrated model, the two variables Perceived Benefits and Perceived Barriers jointly replace the Attitude toward the Behavior variable from the TPB. Furthermore, Perceived Susceptibility and Perceived Severity within the HBM exhibit a high degree of correlation. Precedents exist in previous integrated model research where scholars have combined these two constructs¹³. Thus, this study merged them into a single variable termed Perceived Threat (encompassing perceived risk and severity).

Both Self-Efficacy (HBM) and Perceived Behavioral Control (TPB) pertain to an individual's beliefs about their capabilities: Self-efficacy focuses on confidence in one's own ability, while perceived behavioral control emphasizes the sense of control over the environment or situation. Both significantly influence an individual's behavioral choices and psychological state and should therefore be comprehensively considered in practical applications¹⁴. To streamline the model, this study does not separately discuss self-efficacy. Perceived Behavioral Control encompasses two aspects: capability to perform the behavior and autonomy in performing it¹⁵. The concept of behavioral autonomy is somewhat analogous to behavioral intention. Moreover, within the TPB, perceived behavioral control can also moderate the influence of attitudes and subjective norms on behavioral intention, as well as the influence of behavioral intention on behavior. Behavior is the result of the combined effect of behavioral intention and perceived behavioral control¹⁶. Perceived behavioral control can thus be used alongside behavioral intention to predict the occurrence of behavior, given the correlation between them¹⁷. Consequently, this study introduces a new dimension—"Behavioral Intention and Control (BIC)"—which encompasses the original constructs of perceived behavioral control and behavioral intention.

The integrated model comprises six variables: ☐ Perceived Benefit (PBE), ☐ Perceived Barrier (PBA), ☐ Perceived Threat (PS), ☐ Subjective Norm (SN), ☐ Behavioral Intention and Control (BIC), and ☐ Behavior (B). Table 1 details the integration of the original components from the two models. Definitions of the variables in the newly constructed integrated model are provided in Table 2. The hypothesized path relationships between the model components are illustrated in Fig. 3.

Table 1
Integration of Original Components from Two Theoretical Models

No.	Original Component	Source Model	Composite Model Component
1	Positive Attitude	TPB	☐ Perceived Benefit, ☐ Perceived Barrier
2	Negative Attitude	TPB	
3	Perceived Benefit	HBM	
4	Perceived Barrier	HBM	
5	Perceived Susceptibility	HBM	☐ Perceived Threat
6	Perceived Severity	HBM	
7	Subjective Norm	TPB	☐ Subjective Norm
8	Perceived Behavioral Control	TPB	☐ Behavioral Intention and Control
9	Behavioral Intention	TPB	
10	Self-Efficacy	HBM	
11	Behavior	HBM☐TPB	☐ Behavior

Table 2
Newly constructed composite model building block variable definitions

Variable	Abbreviation	Definition
Perceived Benefit	PBE	Subjective evaluation held by the elderly regarding the potential positive outcomes of engaging in oral health service utilization behavior
Perceived Barrier	PBA	Subjective assessment of the difficulties potentially encountered during the process of oral health service utilization behavior
Perceived Threat	PT	Subjective assessment of the risk of disease and its consequences
Subjective Norm	SN	Individual's subjective perception of social pressure concerning whether or not to adopt oral health service utilization behavior
Behavioral Intention and Control	BIC	Capability and autonomy to perform oral health service utilization behavior
Behavior	B	Oral health service utilization behavior

Note

H1: *Perceived Benefit (PBE) has a positive effect on Behavioral Intention and Control (BIC).*

H2

Perceived Benefit (PBE) has a positive effect on Behavior (B).

H3

Perceived Barrier (PBA) has a negative effect on Behavioral Intention and Control (BIC).

H4

Perceived Barrier (PBA) has a negative effect on Behavior (B).

H5

Perceived Threat (PT) has a positive effect on Behavioral Intention and Control (BIC).

H6

Perceived Threat (PT) has a positive effect on Behavior (B).

H7

Subjective Norm (SN) has a positive effect on Behavioral Intention and Control (BIC).

H8

Subjective Norm (SN) has a positive effect on Behavior (B).

H9

Behavioral Intention and Control (BIC) has a positive effect on Behavior (B).

2.2 Research Methods

2.2.1 Questionnaire Design

A questionnaire was self-developed by integrating the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). This study referenced established scales and drew upon previous research findings to formulate items for each dimension: (1) Items for the Behavior (B), Perceived Benefit (PBE), Perceived Barrier (PBA), and Perceived Threat (PS) dimensions were developed based on the research by Nakazono et al. (1997)¹⁸ and Xiang et al. (2020)¹⁹; (2) Items for Subjective Norm (SN) were adapted from the work of Liu Yuqin (2019)¹³; (3) Items for Behavioral Intention & Control (BIC) were developed referencing studies by Ju Taoran (2018)²⁰ and Sun Tao (2013)²¹.

The questionnaire was specifically designed considering the behavioral and psychological characteristics of the elderly population. It underwent refinement through expert review and a pilot pre-survey before finalization. The final questionnaire comprised 26 items across six dimensions: Behavior (B), Perceived Benefit (PBE), Perceived Barrier (PBA), Perceived Threat (PS), Subjective Norm (SN), and Behavioral Intention & Control (BIC). Given the potentially limited comprehension abilities of elderly respondents, all items utilized a 5-point Likert scale, ranging from "Strongly Disagree" (scored 1) to "Strongly Agree" (scored 5), with higher scores indicating more positive responses.

Questionnaire Quality Assessment: Exploratory Factor Analysis (EFA) extracted six principal components, accounting for a cumulative variance contribution rate of 62.616%. Factor loadings for all items ranged from 0.517 to 0.817. The overall Cronbach's α coefficient for the scale was 0.864, indicating good reliability and validity.

2.2.2 Data Collection

From July to September 2023, a convenience sampling method was employed to recruit 356 elderly individuals from five communities in Foshan and Guangzhou cities for questionnaire surveys. Inclusion Criteria: (1) Aged ≥ 60 years; (2) Cognitively clear and able to complete the questionnaire independently, or able to complete it successfully with assistance from researchers; (3) Provided informed consent and participated in the survey.

Based on established recommendations for minimum sample size in structural equation modeling (e.g., requiring 300 samples for models with 5–7 variables), a target sample size was set. A total of 352 questionnaires were returned. After excluding 26 invalid responses, 326 valid questionnaires were obtained. The scale developed in this study contained 26 measurement items; the final sample size ($n = 326$) met the common "10 times rule" (minimum 10 cases per measured item), allowing for robust exploration of complex variable relationships within the model^{22,23}.

1.2.3 Statistical Analysis

Data processing and analysis were performed using SPSS software (version 19.0) and AMOS software (version 24.0). (1) Descriptive statistics (frequencies, percentages) were used to characterize the sociodemographic profile of the surveyed elderly participants and describe the current status of their oral health service utilization behavior; (2) Structural Equation Modeling (SEM) was employed to assess the goodness-of-fit of the integrated model of elderly oral health service utilization behavior; (3) Effect analysis and path analysis were conducted on the integrated model within the SEM framework.

Results

2.1 Analysis of Sociodemographic Characteristics

This study identified the basic characteristics of the surveyed participants across dimensions including gender, age, education level, place of residence, economic status, and living arrangements. Questionnaire results showed that participants' ages ranged between 60 and 80 years. There were 132 male and 194 female participants. The proportion of participants with education levels above high school or secondary specialized education was relatively low. Only 11% of the elderly respondents self-reported experiencing family economic difficulties. A majority (82.3%) of the elderly lived with their spouse or children. The sample covered younger-old (60–69 years), middle-old (70–79 years), and older-old (≥ 80 years) age groups. Specific details are presented in Table 3.

Univariate analysis was employed to examine the variables of gender, age, education level, etc., within the personal background of the elderly participants, aiming to explore differences in psychological and behavioral manifestations of oral health service utilization across different group characteristics. As these variables could not be incorporated into the Structural Equation Model (SEM), univariate analysis was conducted using SPSS software (version 19.0).

Each of the four background variables—age, education level, economic status, and place of residence—was divided into at least three groups. Therefore, one-way Analysis of Variance (ANOVA) was used to test for between-group differences in each variable across the questionnaire dimensions. Gender and place of residence were divided into only two groups, so independent samples t -tests were used for analysis.

The results indicated: (1) Significant differences were found for gender and age in individual aspects of the model variables; (2) Significant differences were found across multiple aspects for participants grouped by education level, place of residence, and economic status; (3) No significant differences were found among participants grouped by living arrangements ($P > 0.05$). Detailed data are presented in Table 4.

Table 3
Socio-demographic characteristics of older adults interviewed (n = 326)

Group		Percentage (%)	
Variable		Frequency (n)	
Gender	Male	132	40.50%
	Female	194	59.50%
Age (years)	60–69	172	52.80%
	70–79	109	33.40%
	≥ 80	45	13.80%
Education Level	Primary school	112	34.40%
		80	24.50%
	Junior high school		
	High school / Sec. spec.	68	20.90%
		54	16.60%
	College / Associate degree		
	Master's degree+	12	3.70%
Place of Residence	Rural	148	45.40%
	Urban	178	54.60%
Economic Status	Very affluent	10	3.10%
	Relatively comfortable	96	29.40%
	Financially sufficient	184	56.40%
		32	9.80%
	Some financial difficulty		
	Severe financial difficulty	4	1.20%
Living Arrangements	Living alone	48	14.70%
	Living with spouse	142	43.60%
	Living with children	126	38.70%
	Other	10	3.10%

Table 4
Behavioural and psychological variables of oral health service utilisation among the elderly grouped by socio-demographic factors and psych

Factor	Group	Behavior (B) Mean ± SE	Stat.§	Perceived Benefit (PBE) Mean ± SD	Stat.§	Perceived Barrier (PBA) Mean ± SD	Stat.§	Subjective Norm (SN) Mean ± SD	Stat.§	Perceived Threat (PS) Mean ± SD	Stat.§
Gender	Male (n = 132)	2.77 ± 1.08	$t=-1.778$	4.06 ± 0.73	$t=-0.600$	3.08 ± 0.73	$t=-0.290$	3.50 ± 0.95	$t=-2.594^*$	3.39 ± 0.71	$t=-0$
	Female (n = 194)	2.99 ± 1.05		4.11 ± 0.71		3.11 ± 0.75		3.77 ± 0.89		3.44 ± 0.76	
Age (years)	60–69 (n = 172)	2.98 ± 1.03	$F= 3.510^*$	4.15 ± 0.71	$F= 1.370$	3.08 ± 0.77	$F= 1.337$	3.65 ± 0.89	$F= 0.067$	3.51 ± 0.69	$F= 3.55$
	70–79 (n = 109)	2.91 ± 1.06		4.05 ± 0.67		3.06 ± 0.69		3.65 ± 0.92		3.28 ± 0.78	
	≥ 80 (n = 45)	2.56 ± 1.19		3.97 ± 0.83		3.27 ± 0.75		3.70 ± 1.09		3.39 ± 0.76	
Education Level	Primary (n = 112)	2.92 ± 1.06	$F= 8.083^{***}$	3.98 ± 0.71	$F= 3.184^*$	3.22 ± 0.63	$F= 3.276^*$	3.57 ± 0.93	$F= 0.756$	3.34 ± 0.66	$F= 3.71$
	Junior HS (n = 80)	2.92 ± 1.06		4.01 ± 0.78		3.14 ± 0.76		3.69 ± 0.89		3.35 ± 0.83	
	HS/Secondary (n = 68)	3.00 ± 1.09		4.23 ± 0.62		2.83 ± 0.78		3.67 ± 1.05		3.42 ± 0.74	
	College+ (n = 54)	3.23 ± 0.99		4.16 ± 0.76		3.09 ± 0.71		3.71 ± 0.82		3.50 ± 0.71	
	Master's+ (n = 12)	4.00 ± 0.62		4.58 ± 0.35		3.25 ± 1.19		4.00 ± 0.85		4.15 ± 0.59	
Residence	Rural (n = 148)	2.64 ± 1.01	$t=-4.526^{***}$	3.98 ± 0.73	$t=-2.497^*$	3.21 ± 0.65	$t= 2.361^*$	3.58 ± 0.89	$t=-1.399$	3.36 ± 0.72	$t=-1$
	Urban (n = 178)	3.12 ± 1.07		4.18 ± 0.69		3.01 ± 0.81		3.72 ± 0.95		3.46 ± 0.75	
Economic Status	Very affluent (n = 10)	3.23 ± 1.31	$F= 2.988^*$	4.07 ± 0.72	$F= 3.277^*$	3.24 ± 1.09	$F= 1.426^*$	3.90 ± 0.90	$F= 0.478$	3.77 ± 0.79	$F= 0.83$
	Comfortable (n = 96)	2.99 ± 1.06		4.17 ± 0.60		3.01 ± 0.74		3.69 ± 0.88		3.40 ± 0.67	
	Sufficient (n = 184)	2.93 ± 1.04		4.13 ± 0.67		3.10 ± 0.75		3.65 ± 0.94		3.43 ± 0.77	
	Some difficulty (n = 32)	2.46 ± 1.05		3.69 ± 1.06		3.36 ± 0.59		3.53 ± 0.98		3.29 ± 0.78	
	Severe difficulty (n = 4)	2.08 ± 1.32		3.75 ± 1.17		3.10 ± 0.58		3.33 ± 1.25		3.46 ± 0.44	
Living Arrangement	Alone (n = 48)	2.82 ± 1.17	$F= 1.193$	3.98 ± 0.85	$F= 2.010$	3.03 ± 0.67	$F= 1.757$	3.65 ± 0.87	$F= 1.038$	3.41 ± 0.82	$F= 1.26$
	With spouse (n = 142)	2.99 ± 0.96		4.19 ± 0.64		3.18 ± 0.75		3.71 ± 0.86		3.50 ± 0.69	
	With children (n = 126)	2.80 ± 1.12		4.01 ± 0.75		3.01 ± 0.76		3.57 ± 1.01		3.34 ± 0.71	
	Other (n = 10)	3.23 ± 1.40		4.30 ± 0.55		3.36 ± 0.69		4.03 ± 1.02		3.23 ± 1.24	

Notes: §: t^* -value for two-group comparisons; F -value for three or more groups; SE: Standard Error; SD: Standard Deviation; §Significance: $***p < 0.001$, $**p < 0.01$, $*p < 0.05$; Behavior; PBE = Perceived Benefit; PBA = Perceived Barrier; SN = Subjective Norm; PS = Perceived Threat; BIC = Behavioral Intention & Control.

3.2 Descriptive Analysis of Oral Health Service Utilization Behavior

In the behavioral questionnaire:(1)Only 33.72% of elderly participants reported proactively learning about oral health knowledge; (2)A substantial majority (65.7%) indicated they did not proactively seek regular oral check-ups; (3)Merely 51.16% would proactively seek dental treatments (e.g., cleaning, fillings, extractions, dentures, or implants); (4)When acute oral pain affected daily life, 24.71% still reported not seeking timely medical care.

Table 5
Current status of oral health service utilisation behaviours among older people (n = 326)

Item	Strongly Disagree n (%)	Disagree n (%)	Uncertain n (%)	Agree n (%)	Strongly Agree n (%)
Proactively seek oral health knowledge	48 (13.95%)	117 (34.01%)	63 (18.31%)	96 (27.91%)	20 (5.81%)
Schedule regular dental check-ups	66 (19.19%)	101 (29.36%)	59 (17.15%)	91 (26.45%)	27 (7.85%)
Seek preventive/therapeutic dental services (e.g., scaling, fillings, extractions)	51 (14.83%)	77 (22.38%)	40 (11.63%)	134 (38.95%)	42 (12.21%)
Visit dentists promptly for acute oral pain affecting daily life	22 (6.4%)	28 (10.17%)	35 (10.17%)	161 (46.8%)	98 (28.49%)

These empirical findings indicate: (1) Low oral health awareness among the elderly: Both the awareness and behavior of proactively and regularly seeking oral health services were at alarmingly low levels, representing a key intervention point; (2) Inefficient health service utilization: Current oral health service utilization among the elderly is predominantly passive, with low efficiency. Pain-driven utilization (seeking care only when experiencing discomfort) is widespread.

3.3 Validation and Analysis of the Structural Equation Model for Elderly Oral Health Service Utilization Behavior

3.3.1 Model Fit Verification

Based on the theoretically hypothesized model of elderly oral health service utilization behavior established previously, a structural equation model was constructed using AMOS software (version 24.0). In this hypothesized model, four variables—Perceived Benefit (PBE), Perceived Barrier (PBA), Perceived Threat (PS), and Subjective Norm (SN)—were specified as exogenous latent variables, while two variables—Behavioral Intention & Control (BIC) and Behavior (B)—were specified as endogenous latent variables. This framework constituted the structural equation model for "Elderly Oral Health Service Utilization Behavior," schematically represented in Fig. 4.

Prior to conducting path analysis, the reliability and validity of the hypothesized model must be established through model fit assessment—that is, by importing data into the constructed model for estimation. Prevailing methodological consensus holds that overall goodness-of-fit indices provide a feasible means to evaluate the model's fit, verifying the extent to which the hypothesized model aligns with the observed data. Consequently, this study employed a comprehensive set of overall fit indices to assess model adequacy. The global fit of the structural equation model was evaluated across three categories: absolute fit indices, incremental fit indices, and parsimonious fit indices. The formal questionnaire data were imported into AMOS 24.0 for processing. Analysis revealed the following fit indices: absolute fit indices are presented in Table 6, incremental fit indices in Table 7, and parsimonious fit indices in Table 8. Synthesizing these results, the model demonstrated reasonable fit, indicating that the hypothesized model for this study is acceptable.

Table 6
Absolute Fit Indices for Structural Equation Model

Index	Abbr.	Criterion	Value	Evaluation
Chi-square/Degrees of Freedom	χ^2/df	< 3	2.476	Reasonable fit
Root Mean Residual	RMR	0.05–0.08	0.069	Reasonable fit
RMSEA	RMSEA	0.05–0.08	0.067	Reasonable fit
Goodness-of-Fit Index	GFI	> 0.8	0.859	Reasonable fit
Adjusted GFI	AGFI	0.8–0.9	0.823	Reasonable fit

Table 7
Incremental Fit Indices for Structural Equation Model

Index	Abbr.	Criterion	Value	Evaluation
Normed Fit Index	NFI	> 0.8	0.824	Reasonable fit
Relative Fit Index	RFI	> 0.8	0.797	Marginal fit*
Incremental Fit Index	IFI	> 0.8	0.887	Reasonable fit
Tucker-Lewis Index	TLI	> 0.8	0.868	Reasonable fit
Comparative Fit Index	CFI	> 0.8	0.886	Reasonable fit
Note: RFI value (0.797) is marginally below threshold but acceptable given other indices				

Table 8
Parsimonious Fit Indices for Structural Equation Model

Index	Abbr.	Criterion	Value	Evaluation
Parsimonious GFI	PGFI	> 0.5	0.687	Reasonable fit
Parsimonious Normed Fit Index	PNFI	> 0.5	0.712	Reasonable fit
Parsimonious Comparative Fit Index	PCFI	> 0.5	0.768	Reasonable fit

2.3.2 Analysis of Research Path Hypothesis Verification

A core function of constructing a Structural Equation Model (SEM) is to conduct an in-depth analysis of the path dependency relationships among multiple complex variables, aiming to reveal potential patterns of interaction between them. Therefore, following the model fit assessment, it is necessary to further test the original research hypotheses. Path analysis, as an effective tool within SEM suitable for handling continuous variable data, builds upon the analysis of correlations between variables to explore and infer potential causal chains.

This study employed the Maximum Likelihood (ML) method for hypothesis testing of path causal relationships. In testing path coefficients, a research hypothesis is accepted only if the standardized coefficient is significantly different from zero and the p-value is < 0.05. Otherwise, the null hypothesis is retained.

Table 9
path coefficients of the structural equation model of oral health service utilisation behaviour of older people

Path	Unstd. Coeff.	S.E.	C.R.	p-value
BIC←PBE	.276	.067	4.140	***
BIC←PS	.187	.074	2.512	.012
BIC←SN	.337	.065	5.203	***
BIC←PBA	-.070	.064	-1.089	.276
B←BIC	.834	.129	6.461	***
B←PS	-.159	.102	-1.554	.120
B←PBA	-.034	.090	-.382	.702
B←PBE	.330	.097	3.396	***
B←SN	.008	.089	.089	.929
Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; BIC = Behavioral Intention & Control; PBE = Perceived Benefit; PS = Perceived Threat; SN = Subjective Norm; PBA = Perceived Barrier; B = Behavior				

Analysis of Table 9 reveals:(1)Perceived Benefit (PBE) and Subjective Norm (SN) had significant effects on Behavioral Intention & Control (BIC) ($p < 0.001$); (2)Perceived Threat (PS) and Perceived Barrier (PBA) did not have significant effects on BIC ($p > 0.05$);(3)Behavioral Intention & Control (BIC) and Perceived Benefit (PBE) had significant effects on Behavior (B) ($p < 0.001$);(4)Perceived Threat (PS), Perceived Barrier (PBA), and Subjective Norm (SN) did not have significant direct effects on Behavior (B) ($p > 0.05$).

Consequently, the hypothesis validation results are presented in Table 10. As shown, hypotheses H1, H2, H7, and H9 were supported in this study, while the remaining hypotheses were not supported.

Table 10
Hypothesis Validation Results

Hypo.	Statement	Result
H1	Perceived Benefit → Behavioral Intention & Control (+)	Supported
H2	Perceived Benefit → Behavior (+)	Supported
H3	Perceived Barrier → Behavioral Intention & Control (-)	Not Supported
H4	Perceived Barrier → Behavior (-)	Not Supported
H5	Perceived Threat → Behavioral Intention & Control (+)	Not Supported
H6	Perceived Threat → Behavior (+)	Not Supported
H7	Subjective Norm → Behavioral Intention & Control (+)	Supported
H8	Subjective Norm → Behavior (+)	Not Supported
H9	Behavioral Intention & Control → Behavior (+)	Supported

The magnitude of the path relationships, i.e., the influence between latent variables, is expressed through the path coefficients. Extracting the standardized path coefficients and reconstructing the model diagram based on the supported hypotheses (H1, H2, H7, H9), the overall path relationships influencing elderly oral health service utilization behavior are depicted in Fig. 5.

Note

Arrows indicate significant paths. Values represent standardized coefficients. Total effect of BIC on B is 0.593

As illustrated in Fig. 4 – 2, the influence of the four latent variables (PBE, SN, BIC, B) on elderly oral health service utilization behavior manifests through three primary pathways: (1)The variable "Behavioral Intention & Control (BIC)" has a direct positive effect on "Oral Health Service Utilization Behavior (B)", and this path exhibits the largest total effect ($\beta = 0.593$);(2)The variable "Perceived Benefit (PBE)" can both directly positively influence elderly oral health service utilization behavior (B) and indirectly positively influence it through its effect on the "Behavioral Intention & Control (BIC)" variable; (3)The variable "Subjective Norm (SN)" can only indirectly positively influence elderly oral health service utilization behavior (B) through the mediating role of the "Behavioral Intention & Control (BIC)" variable.

2.3.3 Effect Analysis

The effects within the model can be categorized into direct effects, indirect effects, and their composite total effects. The direct effect is represented by the standardized path coefficient between variables. The indirect effect is calculated as the product of the standardized path coefficients along a mediated pathway. The total effect is the sum of the direct and indirect effects. Based on the magnitude of total effects, the primary factors influencing elderly oral health service utilization behavior were ranked in descending order as follows: 1) Behavioral Intention & Control (BIC), 2) Perceived Benefit (PBE), and 3) Subjective Norm (SN). Specific values are presented in Table 11.

Table 11
Analysis of model effects

Dependent Variable	Independent Variable	Direct Effect	Indirect Effect	Total Effect
Behavior (B)	BIC	0.593	-	0.593
	PBE	0.239	0.165	0.404
	SN	-	0.216	0.216
BIC	SN	0.365	-	0.365
	PBE	0.282	-	0.282
Notes: B = Oral Health Service Utilization Behavior; BIC = Behavioral Intention & Control; PBE = Perceived Benefit; SN = Subjective Norm; "-" indicates no effect present.				

The empirical data demonstrate that:(1)The variable "Behavioral Intention & Control (BIC)" exerted the strongest influence on "Oral Health Service Utilization Behavior (B)" (Total Effect = 0.593); (2)The variable "Perceived Benefit (PBE)" had the second strongest influence (Total Effect = 0.404); (3)The variable "Subjective Norm (SN)" had the smallest influence, with no direct effect and only an indirect effect (Indirect Effect = 0.216; Total Effect = 0.216).

Furthermore, regarding the factors influencing "Behavioral Intention & Control (BIC)":Both "Subjective Norm (SN)" and "Perceived Benefit (PBE)" exerted only direct effects (0.365 and 0.282, respectively), with no indirect pathways.

Discussion

This study aimed to identify key factors requiring intervention in elderly oral health service utilization behavior. Utilizing the classic Health Belief Model (HBM) and Theory of Planned Behavior (TPB) frameworks, we integrated and optimized these models considering the specific characteristics of the elderly

population, constructing a composite model to better explain oral health service utilization behavior among older adults. Key findings based on the results are discussed below:

(1) Descriptive Analysis: The Fourth National Oral Health Epidemiological Survey³ revealed concerning oral health status among the 65–74 age group, suggesting a "high need" for oral health services. However, our study on the current status of oral health service utilization among the elderly in China identified a "low utilization" phenomenon. This contradiction between "high need and low utilization" underscores the critical necessity for interventions targeting elderly oral health service utilization behaviors. Therefore, there is an urgent need to intervene on influencing factors to improve the adoption rate of oral health utilization behaviors and promote elderly oral health.

(2) Model Fit Analysis: The model demonstrated reasonable fit indices, indicating its suitability as a tool for explaining and predicting elderly oral health service utilization behavior. Such composite models can offer novel research perspectives and approaches for understanding this complex behavior.

(3) Path Analysis: Three significant pathways ($p < 0.001$) were identified: A direct positive path from "Behavioral Intention & Control (BIC)" to "Oral Health Service Utilization Behavior (B)". When elderly individuals possess stronger behavioral intention and perceived control, their capability and autonomy to perform the behavior are enhanced. These individuals are also more likely to believe in the effectiveness and benefits of utilizing oral health services, thereby increasing the likelihood of performing the behavior. This finding not only aligns with the fundamental assumptions of TPB but is also supported by multiple empirical studies^{24–26}; The influence path of the "Perceived Benefit (PBE)" variable resembles findings by Kiyak et al.²⁷. PBE can both directly positively influence elderly oral health service utilization behavior (B) and indirectly influence it through BIC acting as a mediating variable. This conclusion bridges constructs from distinct models – Perceived Benefit from classic HBM and Behavioral Intention/Perceived Behavioral Control from traditional TPB – establishing a novel influence pathway for elderly oral health service utilization behavior; Subjective Norm (SN) did not establish a direct link with behavior (B) in the composite model. Instead, it exerted an indirect positive effect on elderly oral health service utilization behavior through the mediating role of BIC. This pathway of SN influencing behavior, solely through indirect means, is consistent with the classical TPB.

(4) Effect Analysis: The newly conceptualized "Behavioral Intention & Control (BIC)" demonstrated the most significant influence on "Oral Health Service Utilization Behavior (B)" among all factors (Total Effect = 0.593). Research by Gamma et al. confirms the high correlation between behavioral intention and behavior²⁸. Furthermore, studies²⁹ indicate that perceived behavioral control is a major predictor of both oral health behavioral intention and actual behavior, explaining 34% of behavioral variance. This supports BIC's role as a crucial predictor of elderly oral health service utilization behavior. Perceived Benefit (PBE) ranked second in influence (Total Effect = 0.404), followed by Subjective Norm (SN) (No direct effect, only Indirect Effect = 0.216). In social life, perceived benefit is a powerful driver of individual behavior. Compared to external directives, elderly individuals are more inclined to perform behaviors they perceive as personally beneficial. Furthermore, regarding the factors influencing BIC, both SN and PBE exerted only direct effects (0.365 and 0.282, respectively). As a vulnerable group, elderly individuals often consult family, friends, or healthcare professionals when encountering unfamiliar matters. These opinions significantly impact their behavioral intention and control (SN had a larger direct effect on BIC [0.365] than PBE [0.282]). Concurrently with this social influence, elderly individuals often receive tangible assistance from these sources (e.g., family members providing accompaniment to dental visits). This assistance not only boosts behavioral intention but also directly enhances the resources and capability required to perform oral health service utilization behaviors.

Based on the identified key dimensions—Perceived Benefit (PBE), Subjective Norm (SN), and Behavioral Intention & Control (BIC)—we propose the following multi-level intervention strategies:

(1) Enhancing Perceived Benefit (PBE): Individual/Family Level: Recognize the decline in self-directed learning capacity among the elderly. Family members should actively accompany elders, share relevant oral health knowledge, watch educational TV programs together, consult oral healthcare books with them, and answer their questions; Societal Level: Mainstream media should prioritize oral health promotion. Healthcare institutions could establish specialized medical teams for community outreach programs, enhancing interactivity during educational sessions and bridging the gap with the public through community-based initiatives; Government bodies should optimize the allocation of oral health human resources and reasonably distribute oral healthcare resources to improve service experiences, thereby enhancing perceived benefits.

(2) Leveraging Subjective Norm (SN): Individual Level: It is essential for elderly individuals to actively listen to and consider advice from relatives, friends, or healthcare personnel regarding oral health; Family Level: Families can foster a home environment that values oral health, encourage elders to develop good oral hygiene habits, and regularly remind and accompany them to utilize oral health services; Societal Level: Similar to the family approach, society-wide oral health education should be promoted to cultivate a broader societal atmosphere that prioritizes oral health.

(3) Strengthening Behavioral Intention & Control (BIC): This dimension, encompassing classical concepts of behavioral intention and perceived behavioral control, is the most influential in the model and serves as a proximal determinant of behavior. Recommendations under PBE and SN will inherently contribute to improving BIC levels. Additionally, as BIC includes the capability to perform the behavior, this can be bolstered by external support: Practical Support: Examples include family members accompanying elders to dental appointments and hospitals improving service accessibility and convenience. Core Insight: Genuine care and companionship for elders may be the most effective catalyst for promoting their healthcare-seeking behavior.

Conclusion

Under the analytical framework integrating the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB), this study employed empirical data to investigate the key influencing factors and underlying mechanisms of the "low utilization" phenomenon in oral health service utilization behavior among the elderly.

Within the composite model, the identified influencing factors operate through distinct pathways: (1)The variable "Behavioral Intention & Control (BIC)" exerts a direct positive effect on "Elderly Oral Health Service Utilization Behavior (B)", demonstrating the largest total effect; (2)The variable "Perceived Benefit (PBE)" positively influences elderly oral health service utilization behavior both directly and indirectly by affecting the "Behavioral Intention & Control (BIC)" variable; (3)The variable "Subjective Norm (SN)" can only positively influence elderly oral health service utilization behavior indirectly, mediated through the "Behavioral Intention & Control (BIC)" variable.

Therefore, it is recommended to implement strategies focusing on enhancing social support, addressing cognitive misconceptions, and strengthening the expectations and support from family, friends, and healthcare professionals. These interventions can effectively target Subjective Norm (SN), Behavioral Intention & Control (BIC), and Perceived Benefit (PBE), ultimately promoting proactive utilization of oral health services among the elderly population.

Collectively, this study provides a scientific foundation and effective strategies for improving oral health status among older adults, contributing novel perspectives and insights to advance the process of healthy aging.

Declaration of generative AI and AI-assisted technologies in the writing process.

Statement: During the preparation of this work the author(s) used [Deepseek] in order to [Linguistic refinement]. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

Declarations

Conflict of interest disclosure:

There are no conflicts in relation to this study.

Ethics approval

statement: This cross-sectional study was approved by Board of Medical Ethics Committee of Foshan University (No. 2022001). Written consent from all participants was collected before the implementation of the study. This study was conducted in full accordance with the Helsinki Declaration.

Clinical Trial Registration

Not applicable (observational study).

Patient consent statement

Written consent from all participants was collected before the implementation of the study.

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Author Contribution

(I) Conception and design: Xiaoyuan Pan, Shuwen Su. (II) Administrative support: Shuwen Su. (III) Provision of study materials : Xiaoyuan Pan, Jianli Li, Leyi Han, Xinyue Chen. (IV) Collection and assembly of data: Xiaoyuan Pan, Jianli Li, Leyi Han, Xinyue Chen. (V) Data analysis and interpretation: Shuwen Su, Xiaoyuan Pan, Jianli Li. (VI) Final approval of manuscript: All authors

Data Availability

All data generated or analysed during this study are included in this published article (and its Supplementary Information files). The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figures

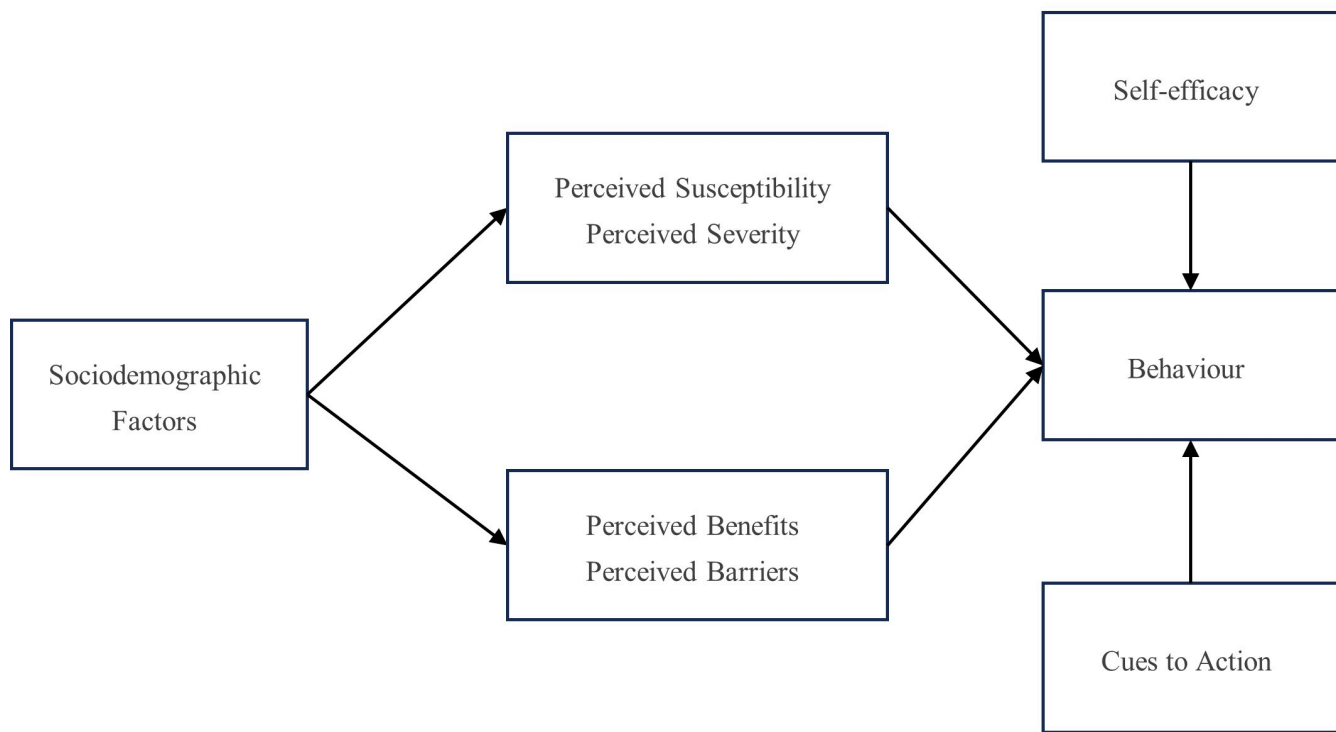


Figure 1

Health Belief Model [HBM]

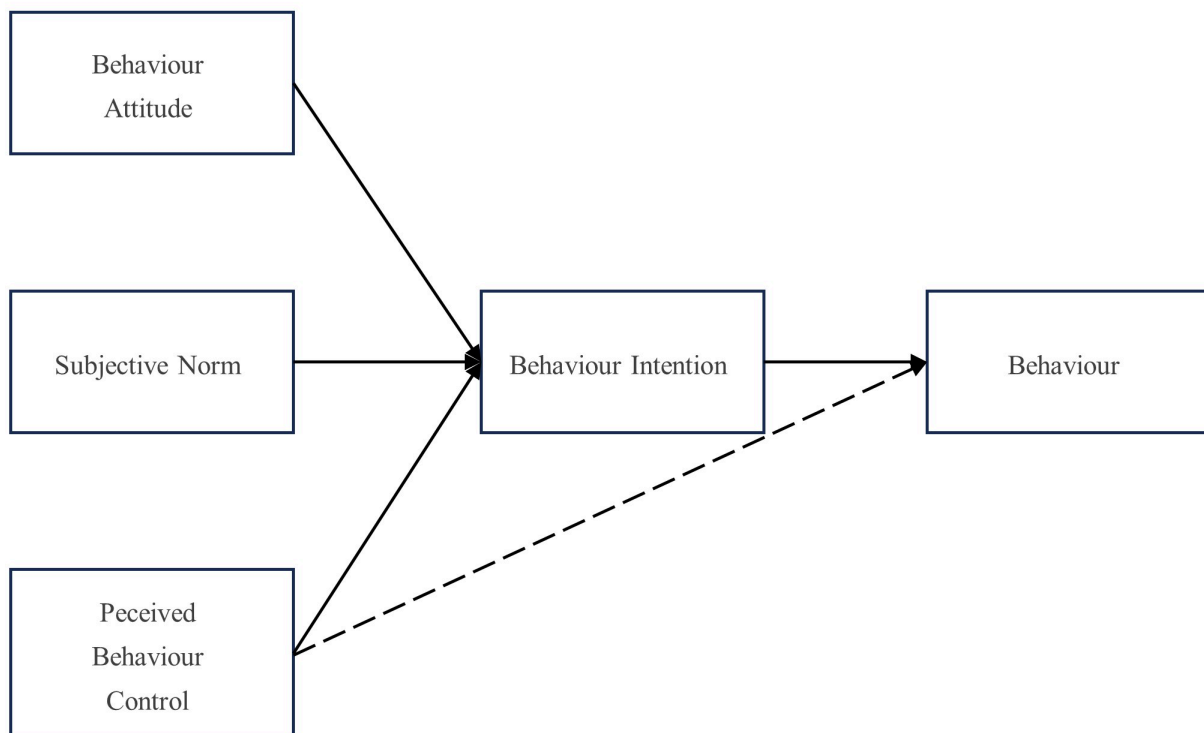


Figure 2

Note: The dashed line signifies that accurate perceived behavioral control can serve as a valid proxy measure for actual control conditions, enabling direct prediction of the likelihood of behavior occurrence

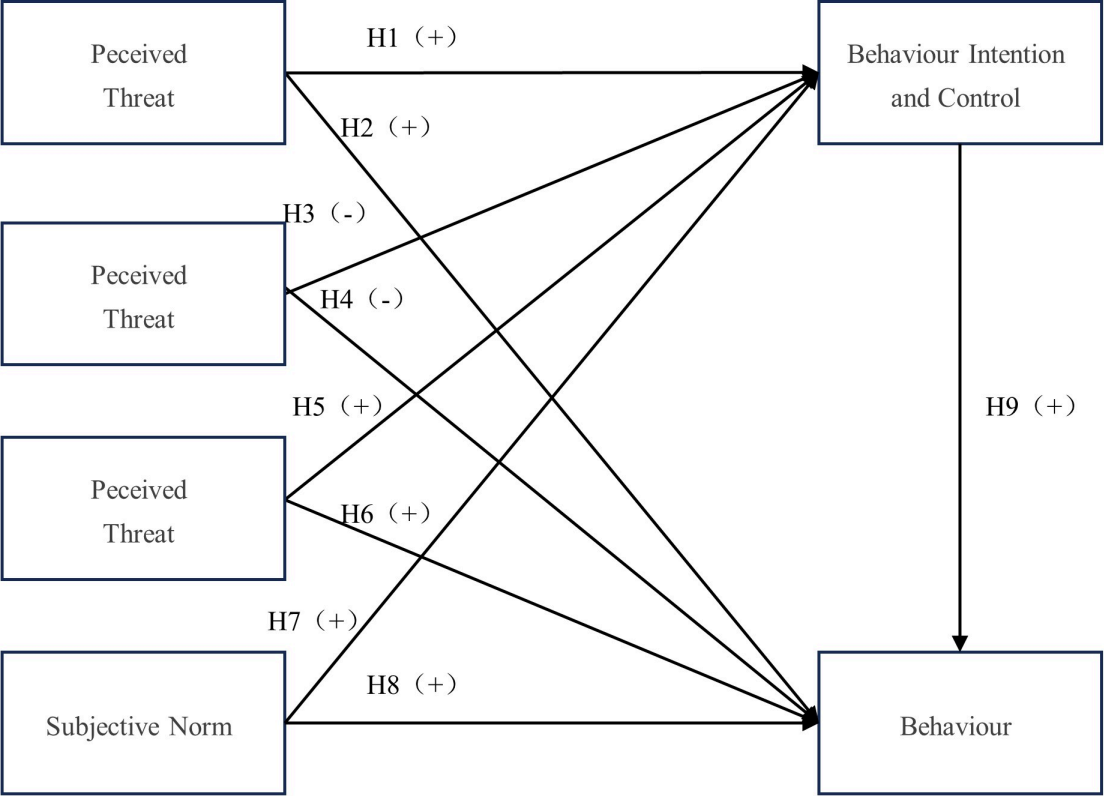


Figure 3

Path relationship assumptions between the newly constructed composite model components

Note: *H1: Perceived Benefit (PBE) has a positive effect on Behavioral Intention and Control (BIC).*

H2: Perceived Benefit (PBE) has a positive effect on Behavior (B).

H3: Perceived Barrier (PBA) has a negative effect on Behavioral Intention and Control (BIC).

H4: Perceived Barrier (PBA) has a negative effect on Behavior (B).

H5: Perceived Threat (PT) has a positive effect on Behavioral Intention and Control (BIC).

H6: Perceived Threat (PT) has a positive effect on Behavior (B).

H7: Subjective Norm (SN) has a positive effect on Behavioral Intention and Control (BIC).

H8: Subjective Norm (SN) has a positive effect on Behavior (B).

H9: Behavioral Intention and Control (BIC) has a positive effect on Behavior (B).

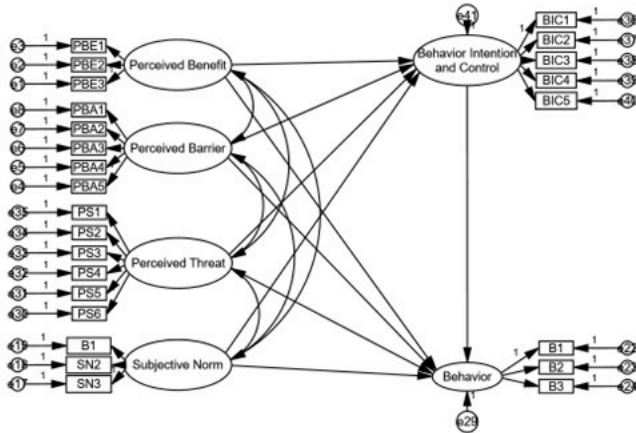


Figure 4

Hypothetical modelling diagram

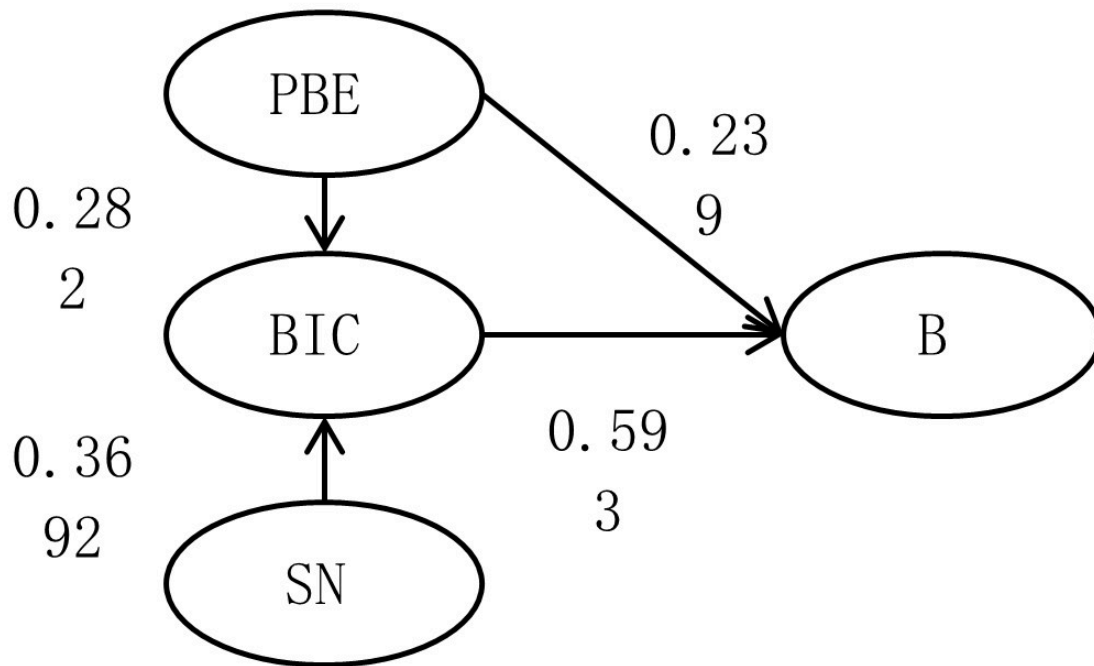


Figure 5

General pathways of behavioural mechanisms for oral health service utilisation by older people

Note: Arrows indicate significant paths. Values represent standardized coefficients. Total effect of BIC on B is 0.593