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Application of Social Cognitive Theory on the Determinants of Tertiary Prevention Behavior and Its Impact on Blood Pressure among Elderly Individuals with Hypertension in Surakarta, Indonesia

Tania Febiola[1)], Argyo Demartoto[1)], Bhisma Murti[1)], Revi Gama Hatta Novika[3)], Erindra Budi Cahyanto[2)], Anik Lestari[3)]

[1)]Master's Program in Public Health, Universitas Sebelas Maret
[2)]Diploma IV of Applied Nursing Anesthesiology, Vocational School, Universitas Sebelas Maret
[3)]Diploma IV of Applied Midwifery, Faculty of Medicine, Universitas Sebelas Maret

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ABSTRACT

Background: Hypertension is a noncommunicable disease that commonly affects older adults and may lead to serious complications. Effective hypertension control also depends on tertiary preventive behaviors. This study aimed to examine the reduction of hypertension through tertiary preventive behaviors and to analyze the direct and indirect effects of Social Cognitive Theory constructs on tertiary preventive behaviors and systolic blood pressure among older adults with hypertension.
Subjects and Method: This cross-sectional study was conducted in Surakarta, Indonesia. A multistage random sampling technique was employed, resulting in the selection of seven community health centers (Puskesmas) and a total sample of 211 respondents. Data were collected using questionnaires that had been tested for validity and reliability. Multivariate data analysis was performed using path analysis.
Results: Tertiary preventive behavior was directly and significantly influenced by behavioral skills (b= 0.26; 95% CI= 0.11 to 0.40; p = 0.001), reinforcement (b = 0.23; 95% CI = 0.10 to 0.36; p = 0.001), self-regulation (b = 0.16; 95% CI = 0.02 to 0.30; p = 0.021), observational learning (b = 0.18; 95% CI = 0.06 to 0.30; p = 0.003), and female sex (b= 0.12; 95% CI= 0.02 to 0.21; p = 0.013). Systolic blood pressure was directly and significantly associated with tertiary preventive behavior in a negative direction (b= −0.14; 95% CI= −0.27 to −0.02; p= 0.027), indicating that better tertiary preventive behavior was associated with lower systolic blood pressure. In contrast, body mass index (b= 0.19; 95% CI = 0.06 to 0.32; p = 0.003) and age (b= 0.21; 95% CI= 0.08 to 0.34; p= 0.001) showed positive associations with systolic blood pressure. Sex was not significantly associated with systolic blood pressure. Outcome expectations indirectly influenced tertiary preventive behavior through self-efficacy and subsequently through behavioral skills.
Conclusion: Tertiary preventive behavior is influenced by key constructs of Social Cognitive Theory and plays an important role in reducing systolic blood pressure among older adults with hypertension.

Keywords: hypertension, older people, Social Cognitive Theory

Correspondence:
Argyo Demartoto. Faculty of Social and Political Sciences, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta, Central Java 57126, Indonesia. Email: argyodemartoto_fisip@staff.uns.ac.id.

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BACKGROUND

According to the World Health Organization (WHO), hypertension, or high blood pressure, is a serious medical condition that significantly increases the risk of heart, brain, kidney, and other diseases. In 2021, an estimated 1.28 billion adults aged 30–79 years worldwide were living with hypertesion, with approximately two-thirds residing in low- and middle-income countries. Older adults are particularly vulnerable to degenerative diseases, including coronary heart disease, hypertension, diabetes mellitus, rheumatic disorders, and cancer (Wulandari et al., 2023). Among these conditions, hypertension is one of the most prevalent among older adults. Hypertension is often referred to as a "silent killer" because it typically presents without noticeable symptoms. However, its asymptomatic nature does not diminish its severity. The prevalence of hypertension tends to increase with age, although evidence also indicates that it increasingly affects young adults and individuals in early middle age (Wulandari et al., 2023).

Aging is a natural and gradual process influenced by various factors, resulting in different rates of aging among individuals. Throughout the life cycle, humans eventually enter older adulthood, generally defined as 60 years of age or older. As people age, physiological functions progressively decline, including the ability of cells and tissues to repair themselves and defend against infections, thereby increasing susceptibility to various diseases (WHO, 2022). Hypertension is characterized by persistently elevated blood pressure levels above the normal range, as indicated by systolic and diastolic blood pressure measurements. It is defined as a systolic blood pressure greater than 140 mmHg and/or a diastolic blood pressure greater than 90 mmHg, confirmed by at least two measurements taken five minutes apart while the individual is in a sufficiently rested and calm condition (Pudiastuti, 2019).

According to the World Health Organization (WHO), approximately one billion people worldwide are living with hypertension, with nearly two-thirds residing in low- and middle-income developing countries. Without effective prevention and control measures, this number is expected to continue increasing, reaching an estimated 1.6 billion people, or 29% of the global population, by 2025. WHO reported that approximately 972 million people, representing 26.4% of the world's population, were affected by hypertension in 2019. By 2022, the number had risen to approximately 1.13 billion individuals, indicating that one in three adults worldwide had been diagnosed with hypertension (WHO, 2023).

In Indonesia, data from the Ministry of Health indicate that the prevalence of hypertension among older adults is 45.9% among those aged 55–64 years, 57.6% among those aged 65–74 years, and 63.8% among those aged over 75 years. Based on blood pressure measurements, the overall prevalence of hypertension among individuals aged 18 years and older was reported to be 25.8%. The highest prevalence was observed in the Province of Bangka Belitung (30.9%), followed by South Kalimantan (30.8%) and East Kalimantan (29.6%) (Ministry of Health of the Republic of Indonesia, 2019).

Most hypertension-related complications occur as a result of delayed disease control and poor adherence to treatment

and lifestyle modifications. However, hypertension can be effectively managed through a combination of pharmacological therapy and tertiary preventive behaviors, including medication adherence, regular blood pressure monitoring, adherence to a low-sodium diet, engagement in regular physical activity, stress management, and weight control (WHO, 2023; Whelton et al., 2018). Tertiary prevention aims to prevent further complications and improve the quality of life of individuals with hypertension. Efforts to control hypertension are aligned with Sustainable Development Goal (SDG) 3, which seeks to reduce premature mortality from noncommunicable diseases by one-third through prevention and treatment, while promoting health and well-being for all by 2030 (WHO, 2020).

To achieve these targets, clinical approaches must be complemented by sustainable health behavior change strategies. Health behavior can be explained through various theoretical frameworks, one of the most relevant being the Social Cognitive Theory (SCT) developed by Albert Bandura. This theory posits that behavior is the result of reciprocal interactions among personal factors, environmental influences, and behavior itself, a concept known as triadic reciprocal determinism (Bandura, 1986). The principal constructs of SCT include self-efficacy, outcome expectations, observational learning, reinforcement, and self-regulation.

Self-efficacy, defined as an individual's belief in their ability to perform a specific behavior, has been shown to play a critical role in treatment adherence and chronic disease management (Bandura, 1997; Marks et al., 2005). Among individuals with hypertension, higher self-efficacy is associated with better medication adherence, greater consistency in physical activity, and healthier dietary practices (Warren-Findlow & Seymour, 2011). In addition, self-regulation enables individuals to maintain healthy behaviors over time through goal setting, self-monitoring, and behavioral evaluation (Bandura, 2001).

Although numerous studies have demonstrated the importance of self-efficacy in hypertension management, comprehensive investigations examining the influence of all major Social Cognitive Theory constructs on tertiary preventive behaviors and their subsequent impact on blood pressure among older adults remain limited, particularly within primary healthcare settings. A preliminary study conducted at elderly integrated health service posts (Posyandu Lansia) in Surakarta City in 2025 identified a substantial number of older adults with uncontrolled blood pressure despite receiving antihypertensive treatment. Several participants reported inconsistent medication use, infrequent routine health checkups, and suboptimal adherence to dietary recommendations and physical activity guidelines. These findings suggest that behavioral and psychosocial factors may play an important role in hypertension control.

Therefore, this study aimed to analyze the effects of Social Cognitive Theory constructs on tertiary preventive behaviors and to examine their impact on blood pressure among older adults with hypertension.

SUBJECTS AND METHOD

1. Study Design

This study employed an analytical observational design with a cross-sectional study. The research was conducted at seven community health centers (Puskesmas) in Surakarta, Central Java, Indonesia, from August to September 2025.

2. Population and Sample

The target population consisted of older adults aged 60 years and above residing in Surakarta City. A total of 211 respondents were included in the study. Participants were selected using a multistage random sampling technique.

3. Study Variables

The independent variables included self-efficacy, observational learning, outcome expectations, reinforcement, self-regulation, behavioral capability, age, sex, body mass index (BMI), and tertiary preventive behavior. The dependent variable was systolic blood pressure.

4. Operational Definition of Variables

Self-efficacy was defined as older adults' confidence in their ability to perform hypertension control behaviors.

Observational learning referred to older adults' ability to learn hypertension control behaviors by observing others, healthcare professionals, or family members.

Outcome expectations were defined as older adults' beliefs regarding the benefits or outcomes of engaging in tertiary preventive behaviors for hypertension, such as maintaining controlled blood pressure and preventing complications.

Reinforcement referred to support received from the environment that motivates older adults to engage in tertiary preventive behaviors for hypertension.

Self-regulation was defined as the ability of older adults to manage, monitor, and consistently maintain healthy behaviors for hypertension control.

Behavioral capability referred to older adults' knowledge and skills necessary to perform tertiary preventive behaviors for hypertension.

Age was defined as the respondent's length of life, calculated from the date of birth to the date of measurement.

Sex referred to the respondent's biological identity recognized within society.

Body Mass Index (BMI) was defined as a standard measure used to assess nutritional status and ideal body weight based on the ratio of body weight to height.

Tertiary preventive behavior referred to actions undertaken by older adults to control hypertension and prevent its complications.

Systolic blood pressure was defined as the force exerted by circulating blood against arterial walls during cardiac contraction and was measured using a sphygmomanometer.

5. Study Instrument

Data were collected using a structured questionnaire consisting of 26 items, including 3 items assessing self-regulation, 3 items assessing self-efficacy, 3 items assessing observational learning, 3 items assessing reinforcement, 3 items assessing outcome expectations, 3 items assessing behavioral capability, and 8 items assessing tertiary preventive behavior.

6. Data Analysis

Univariate analysis was conducted to describe the frequency distribution of the study variables. Multivariate analysis was performed using path analysis to examine the direct and indirect relationships among variables. All statistical analyses were conducted using STATA version 13.

7. Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of Dr. Moewardi Regional General Hospital, with reference number 1.900/VIII/HREC/2025, issued on August 29, 2025.

RESULTS

1. Sample Characteristics

The characteristics of the study participants and categorical study variables are presented in Table 1. The majority of respondents were female, accounting for 148 individuals (70.14%). Regarding age

distribution, most participants were in the 60–69 years age group, comprising 179 individuals (84.83%). In terms of educational attainment, the majority had completed primary to secondary education (elementary school, junior high school, or senior high school), totaling 173 respondents (81.99%).

Table 1. Characteristics of the Respondents.

Sample characteristics	Category	n	%
Age	50-59 years old	4	1.90
	60-69 years old	179	84.83
	70-79 years old	25	11.85
	≥ 80 years old	3	1.42
Sex	Male	63	29.86
	Female	148	70.14
Education	< Senior high school	173	81.99
	College	38	18.01
BMI	<18.5 (Underweight)	8	3.79
	18.5-22.9 (Normal weight)	87	41.23
	23.0-24.9 (Overweight)	61	28.91
	25.0-29.9 (Obese grade I)	52	24.64
	≥30.0 (Obese II)	3	1.42

Table 2 presents the descriptive statistics of the continuous study variables among older adults with hypertension. The mean age of the respondents was reported as shown in Table 2. The mean score for observational learning was 12.77 (SD = 2.27), while the mean score for outcome expectations was 13.62 (SD = 2.03). The mean score for reinforcement was 12.94 (SD = 2.50), and the mean score for self-regulation was 12.45 (SD = 2.65). The mean score for behavioral capability was 12.76 (SD = 2.33), whereas the mean score for self-efficacy was 13.27 (SD = 2.01). The mean score for tertiary preventive behavior was 27.16 (SD = 5.12). The mean systolic blood pressure was 142.73 mmHg (SD = 9.76).

Table 2. Univariate Analysis of Continuous Variables

Variables	Mean	SD	Min.	Max.
Age (years old)	64.22	4.81	50	89
BMI (kg/m^2)	23.35	3.00	14.22	32.44
Observational learning	12.77	2.27	5	15
Outcome expectation	13.62	2.03	7	15
Reinforcement	12.94	2.50	5	15
Self-regulation	12.45	2.65	5	15
Behavior ability	12.76	2.33	5	15
Self-efficacy	13.27	2.01	3	15
Tertiary preventive behavior	27.16	5.12	13	38
Systolic blood pressure (mmHg)	142.73	9.76	114	173

2. Bivariate analysis

Bivariate analysis was conducted to examine the relationships between the independent variables and the dependent variables among older adults with hypertension. The results of the simple linear regression analyses are presented in Table 3.

Table 3 shows that observational learning (b= −0.55; 95% CI = −1.13 to 0.02; p = 0.061), outcome expectations (b= −0.43; 95% CI= −1.09 to 0.21; p= 0.186), self-regulation (b= −0.46; 95% CI= −0.96 to 0.03; p = 0.068), behavioral capability (b= −0.42; 95% CI= −0.99 to 0.13; p = 0.139), and self-efficacy (b= −0.08; 95% CI = −0.74 to 0.56; p= 0.789) were not significantly associated with tertiary preventive behavior. These findings indicate that a one-unit increase in the scores of observational learning, outcome expectations, self-regulation, behavioral capability, or self-efficacy was not associated with a statistically significant change in tertiary preventive behavior scores.

In contrast, reinforcement showed a significant negative association with tertiary preventive behavior (b= −0.68; 95% CI= −1.21 to −0.16; p= 0.010). This result suggests that a one-unit increase in the reinforcement score was associated with a 0.68-unit decrease in the tertiary preventive behavior score.

Furthermore, a significant positive association was observed between age and systolic blood pressure (b = 0.52; 95% CI = 0.26 to 0.79; p < 0.001). Each additional year of age was associated with an increase of 0.52 mmHg in systolic blood pressure among older adults with hypertension.

A significant negative association was also found between tertiary preventive behavior and systolic blood pressure (b = −0.33; 95% CI = −0.59 to −0.08; p = 0.010). This finding indicates that a one-unit increase in the tertiary preventive behavior score was associated with a reduction of 0.33 mmHg in systolic blood pressure.

Table 3. Results of simple linear regression analyses of factors associated with tertiary preventive behavior and systolic blood pressure among older adults with hypertension.

Independent Variables	b	95% CI		p
		Lower limit	Upper limit	
Tertiary preventive behavior				
Observational learning	-0.05	-1.13	0.02	0.061
Outcome expectation	-0.43	-1.09	0.21	0.186
Reinforcement	-0.68	-1.21	-0.16	0.010
Self-regulation	-0.46	-0.96	0.03	0.068
Behavior ability	-0.42	-0.99	0.13	0.139
Self-efficacy	-0.08	-0.74	0.56	0.789
Age	-0.14	-0.28	0.00	0.050
Sex	-1.48	-4.37	1.41	0.315
Systolic blood pressure				
Sex	-1.48	-4.37	1.41	0.315
BMI	0.74	0.31	1.17	0.001
Age	0.52	0.26	0.79	0.001
Tertiary preventive behavior	-0.33	-0.59	-0.08	0.010

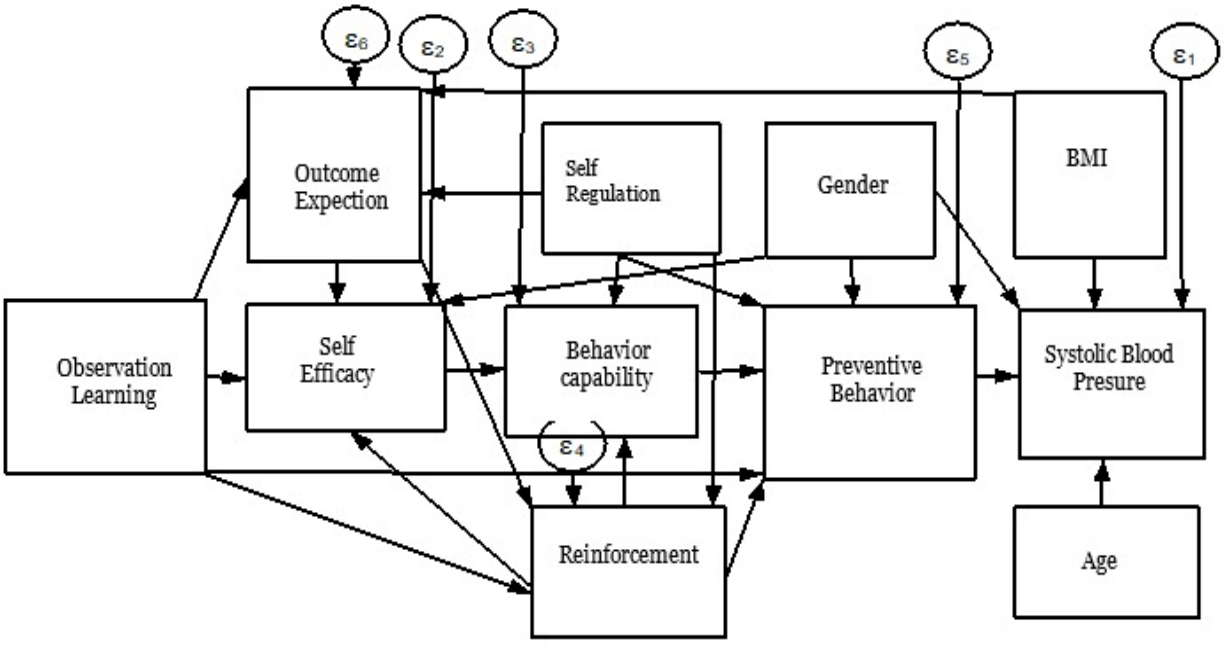

Figure 1. Structural Path Analysis Model of the Influence of Social Cognitive Theory Constructs on Tertiary Preventive Behavior Among Older Adults with Hypertension

3. Path analysis

Path analysis was performed to examine the direct and indirect effects among the study variables. The structural model illustrating the influence of Social Cognitive Theory (SCT) constructs on tertiary preventive behavior among older adults with hypertension is presented in Figure 1. The results of the path analysis indicate that tertiary preventive behavior among older adults with hypertension is influenced by several factors through both direct and indirect pathways. Specifically, tertiary preventive behavior was directly influenced by self-efficacy, behavioral capability, and reinforcement.

Furthermore, self-efficacy was directly influenced by reinforcement, outcome expectations, self-regulation, observational learning, and sex. In addition, behavioral capability was directly affected by self-efficacy, reinforcement, outcome expectations, self-regulation, observational learning, body mass index (BMI), and sex.

Regarding the clinical outcome, systolic blood pressure was directly influenced by tertiary preventive behavior, age, and BMI. These findings suggest that Social Cognitive Theory constructs contribute to hypertension control both directly and indirectly by shaping tertiary preventive behaviors, which subsequently affect systolic blood pressure among older adults with hypertension.

a. Model Identification

The study included 11 observed variables, consisting of five exogenous variables and six endogenous variables, with a total of 29 estimated parameters. The model yielded 26 degrees of freedom (df = 26), indicating that the path analysis model was overidentified and therefore suitable for estimation and hypothesis testing.

b. Model fit

The goodness-of-fit statistics demonstrated that the proposed model adequately fit the observed data: χ^2 (23) = 33.11, p = 0.079; RMSEA = 0.05 (90% CI = 0.01–0.08); CFI=

0.98; TLI= 0.97; SRMR= 0.03; and coefficient of determination (CD)= 75%. These indices indicate an overall good model fit, suggesting that the hypothesized model was consistent with the observed data.

c. Parameter estimation

Determinants of self-efficacy

Table 4 shows that reinforcement, outcome expectations, observational learning, and female sex were positively and significantly associated with self-efficacy. An increase of one unit in the reinforcement score was associated with a 0.21-unit increase in the self-efficacy score (b= 0.21; 95% CI= 0.08 to 0.34; p= 0.002). Similarly, a one-unit increase in outcome expectations was associated with a 0.24-unit increase in self-efficacy (b= 0.24; 95% CI= 0.096 to 0.39; p= 0.001).

In addition, a one-unit increase in the observational learning score was associated with a 0.22-unit increase in self-efficacy (b= 0.22; 95% CI= 0.07 to 0.36; p= 0.003). Female respondents also demonstrated significantly higher self-efficacy scores than male respondents, with female sex associated with a 0.15-unit increase in self-efficacy (b= 0.15; 95% CI= 0.04 to 0.26; p= 0.006).

Determinants of behavior capability

Table 4 indicates that behavioral capability, reinforcement, self-regulation, observationnal learning, and female sex were positively and significantly associated with tertiary preventive behavior among older adults with hypertension. A one-unit increase in the behavioral capability score was associated with a 0.26-unit increase in tertiary preventive behavior (b = 0.26; 95% CI = 0.11 to 0.41; p= 0.001). Similarly, a one-unit increase in reinforcement was associated with a 0.23-unit increase in tertiary preventive behavior (b = 0.23; 95% CI = 0.10 to 0.36; p = 0.001).

In addition, a one-unit increase in the self-regulation score was associated with a 0.16-unit increase in tertiary preventive behavior (b= 0.16; 95% CI = 0.02 to 0.30; p= 0.021), while a one-unit increase in the observational learning score was associated with a 0.18-unit increase in tertiary preventive behavior (b= 0.18; 95% CI= 0.06 to 0.29; p = 0.003). Female respondents also demonstrated significantly higher tertiary preventive behavior scores than male respondents. Being female was associated with a 0.12-unit increase in tertiary preventive behavior (b= 0.12; 95% CI = 0.02 to 0.21; p = 0.013).

Determinants of tertiary preventive behavior

Table 4 indicates that behavioral capability, reinforcement, self-regulation, observational learning, and female sex were positively and significantly associated with tertiary preventive behavior among older adults with hypertension. A one-unit increase in the behavioral capability score was associated with a 0.26-unit increase in tertiary preventive behavior (b = 0.26; 95% CI = 0.11 to 0.41; p = 0.001). Similarly, a one-unit increase in reinforcement was associated with a 0.23-unit increase in tertiary preventive behavior (b= 0.23; 95% CI = 0.10 to 0.36; p = 0.001).

In addition, a one-unit increase in the self-regulation score was associated with a 0.16-unit increase in tertiary preventive behavior (b= 0.16; 95% CI = 0.02 to 0.30; p= 0.021), while a one-unit increase in the observational learning score was associated with a 0.18-unit increase in tertiary preventive behavior (b = 0.18; 95% CI = 0.06 to 0.29; p = 0.003). Female respondents also demonstrated significantly higher tertiary preventive behavior scores than male respondents. Being female was associated with a 0.12-unit increase in tertiary

preventive behavior (b = 0.12; 95% CI = 0.02 to 0.21; p = 0.013).

Determinants of reinforcement

Table 4 shows that outcome expectations, self-regulation, and observational learning were positively and significantly associated with reinforcement. A one-unit increase in the outcome expectations score was associated with a 0.23-unit increase in reinforcement (b = 0.23; 95% CI = 0.10 to 0.36; p = 0.001). Likewise, a one-unit increase in self-regulation was associated with a 0.40-unit increase in reinforcement (b= 0.40; 95% CI= 0.28 to 0.51; p <0.001). A one-unit increase in the observational learning score was associated with a 0.18-unit increase in reinforcement (b = 0.18; 95% CI = 0.04 to 0.31; p = 0.009).

Determinants of outcome expectation

Table 4 demonstrates that self-regulation, body mass index (BMI), and observational learning were positively and significantly associated with outcome expectations. A one-unit increase in the self-regulation score was associated with a 0.26-unit increase in outcome expectations (b = 0.26; 95% CI = 0.15 to 0.38; p < 0.001). Similarly, a one-unit increase in BMI was associated with a 0.13-unit increase in outcome expectations (b= 0.13; 95% CI = 0.04 to 0.23; p = 0.008). In addition, observational learning showed a strong positive association with outcome expectations. A one-unit increase in the observational learning score was associated with a 0.49-unit increase in outcome expectations (b = 0.49; 95% CI = 0.39 to 0.59; p < 0.001).

Determinants of systolic blood pressure

Table 4 shows that tertiary preventive behavior was negatively associated with systolic blood pressure, whereas body mass index (BMI) and age were positively associated with systolic blood pressure. All of these associations were statistically significant. A one-unit increase in the tertiary preventive behavior score was associated with a 0.14-unit decrease in systolic blood pressure (b = −0.14; 95% CI = −0.27 to −0.02; p = 0.027). This finding suggests that greater adherence to tertiary preventive behaviors contributes to better blood pressure control among older adults with hypertension.

In contrast, a one-unit increase in BMI was associated with a 0.19-unit increase in systolic blood pressure (b = 0.19; 95% CI = 0.06 to 0.32; p = 0.003). Similarly, a one-unit increase in age was associated with a 0.21-unit increase in systolic blood pressure (b = 0.21; 95% CI = 0.08 to 0.34; p = 0.001). Meanwhile, no significant difference in systolic blood pressure was observed between male and female participants (b = 0.04; 95% CI = −0.09 to 0.17; p = 0.570).

Table 4. Path Analysis Results of Social Cognitive Theory Constructs on Tertiary Preventive Behavior Among Older Adults with Hypertension

Dependent variables		Independent variables	b	95 % CI		p
				Lower limit	Upper limit	
Self-efficacy	←	Reinforcement	0.21	0.08	0.34	0.002
	←	Outcome expectation	0.24	0.10	0.39	0.001
	←	Observational learning	0.22	0.08	0.36	0.003
	←	Sex (female)	0.15	0.04	0.26	0.006
Behavior capability	←	Self-efficacy	0.40	0.32	0.49	< 0.001
	←	Reinforcement	0.27	0.18	0.37	< 0.001
	←	Self-regulation	0.37	0.27	0.46	< 0.001

Dependent variables		Independent variables	b	95 % CI		p
				Lower limit	Upper limit	
Tertiary preventive behavior	←	Behavior capability	0.26	0.12	0.41	0.001
	←	Reinforcement	0.23	0.10	0.36	0.001
	←	Self-regulation	0.16	0.02	0.30	0.021
	←	Observational learning	0.18	0.06	0.29	0.003
	←	Sex (female)	0.12	0.02	0.21	0.013
Reinforcement	←	Outcome expectation	0.23	0.10	0.36	0.001
	←	Self-regulation	0.40	0.28	0.51	< 0.001
	←	Observational learning	0.18	0.04	0.31	0.009
Outcome expectation	←	Self-regulation	0.26	0.15	0.38	< 0.001
	←	BMI	0.13	0.04	0.23	0.008
	←	Observational learning	0.49	0.39	0.59	< 0.001
Systolic blood pressure	←	Tertiary preventive behavior	-0.14	-0.27	-0.02	0.027
	←	BMI	0.19	0.06	0.32	0.003
	←	Age	0.21	0.08	0.34	0.001
	←	Sex (female)	0.04	-0.09	0.17	0.567
N observation= 211 Log likelihood= -5110.36 Chi square p= 0.079 RSMEA= 0.05 CFI= 0.98 TLI= 0.97; SRMR= 0.03 CD= 75%						

DISCUSSION

Behavioral Capability and Tertiary Preventive Behavior

Behavioral capability demonstrated the strongest direct effect on tertiary preventive behavior. This capability encompasses essential skills for hypertension management, including adherence to a low-sodium diet, engagement in regular physical activity, medication adherence, and routine health monitoring. These findings are consistent with Bandura's concept of behavioral capability, which emphasizes that successful health behavior change requires not only knowledge but also the practical skills necessary to perform and sustain the desired behaviors (Bandura, 1997).

The present findings are supported by previous studies. Warren-Findlow et al. (2012) reported that patients with better self-management abilities exhibited higher levels of treatment adherence. Similarly, Maeda et al. (2013) found that such skills contributed to more effective blood pressure control and a reduced risk of hypertension-related complications. More recent evidence from Liu et al. (2025) demonstrated that self-management skills are effective in lowering blood pressure and improving health behaviors among individuals with hypertension. Conversely, inadequate self-management capability has been identified as a major barrier to effective hypertension control and is associated with an increased risk of complications (Wen et al., 2025).

Reinforcement and Tertiary Preventive Behavior

Reinforcement was found to have a significant direct effect on tertiary preventive behavior. This finding suggests that social support from family members, healthcare providers, and the surrounding environment plays an important role in enhancing individuals' motivation to engage in healthy behaviors. Such support functions as a form of reinforcement, serving as an external stimulus that encourages the adoption and

maintenance of health-promoting behaviors. Individuals who receive emotional, informational, and instrumental support are more likely to adhere to recommendations for hypertension management.

This finding is consistent with the Social Cognitive Theory, which emphasizes the role of reinforcement in strengthening and sustaining behavioral change. Positive reinforcement increases the likelihood that individuals will continue engaging in desired behaviors by providing encouragement, recognition, and support (Bandura, 1997).

Previous studies have reported similar findings. Ogedegbe et al. (2014) stated that social support was significantly associated with improved medication adherence among patients with hypertension. Furthermore, Schwarzer and Luszczynska (2015) highlighted the importance of environmental factors in facilitating behavior change through motivational processes and social support mechanisms. More recent studies by Shahin et al. (2021), Zhang et al. (2021), and Pan et al. (2021) further confirmed that social support enhances self-management, improves quality of life, and promotes medication adherence, all of which are essential components of tertiary prevention in hypertension management.

Self-Regulation and Tertiary Preventive Behavior

Self-regulation was found to have a significant direct effect on tertiary preventive behavior. This finding indicates that an individual's ability to control, monitor, and evaluate their behavior plays a crucial role in maintaining healthy behaviors over time. Self-regulation enables individuals to consistently adhere to healthy lifestyle practices and adjust their actions according to their health conditions. From a theoretical perspective, Conner and Norman (2022) emphasized that self-regulation serves as a key mechanism for bridging the intention–behavior gap, enabling individuals to translate their intentions into actual health-related actions.

Previous studies support this finding. Kim et al. (2023) reported that self-regulation was significantly associated with improved self-care behaviors among individuals with chronic diseases. Similarly, Jung and Moon (2023), He et al. (2024), and Soleimani et al. (2024) demonstrated that self-care and self-management, as manifestations of self-regulation, play important roles in maintaining health stability, improving quality of life, and preventing hypertension-related complications. Therefore, strengthening self-regulatory skills may represent an important strategy for enhancing the effectiveness of tertiary prevention among older adults with hypertension.

Observational Learning and Tertiary Preventive Behavior

Observational learning showed a significant direct effect on tertiary preventive behavior. This finding suggests that healthy behaviors can be acquired through observing others within one's social environment, including family members, peers, and healthcare professionals. According to Bandura (1997), observational learning is one of the primary pathways through which behavior is acquired, highlighting the importance of social interactions in facilitating the adoption of adaptive health behaviors.

This finding is consistent with previous research. Naeemi et al. (2022) found that educational interventions incorporating social learning elements improved self-care abilities among older adults with hypertension, thereby supporting tertiary prevention and reducing the risk of long-term complications. Similarly, Wijayati et al. (2024) reported that peer-based observational learning enhanced the

adoption of healthy behaviors. Liu et al. (2024) further demonstrated that social interaction and observational learning strengthened disease self-management behaviors. In addition, Upoyo et al. (2024) showed that group-based educational programs involving interaction and observation effectively enhanced self-care practices among individuals with hypertension.

Sex (Female) and Tertiary Preventive Behavior

Sex was also found to have a direct effect on tertiary preventive behavior, although its contribution was relatively modest. This finding suggests that differences in health behaviors between men and women may be influenced by social and cultural constructs, including gender-related roles in health decision-making. Such differences may affect how individuals manage hypertension throughout their lives, particularly in the context of tertiary prevention. Women generally demonstrate greater engagement in health-promoting behaviors, which may contribute to more effective disease management and control compared with men.

Previous studies have reported similar findings. Arshed et al. (2025) found that demographic characteristics, including sex, were associated with adherence to antihypertensive medication among patients with hypertension. Yeo et al. (2024) reported that sex influences hypertension management patterns across different age groups. Likewise, Alhawari et al. (2025) found that women achieved better blood pressure control, largely due to higher levels of treatment adherence. These findings are consistent with those of Daugherty et al. (2022) and Bugeja et al. (2024), who demonstrated that women were generally more successful in controlling blood pressure and were more actively involved in hypertension monitoring and management in accordance with clinical guidelines. Such behaviors reflect more effective engagement in tertiary preventive practices.

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AUTHOR CONTRIBUTIONS

TF contributed to the study conception and design, data collection and analysis, interpretation of findings, and manuscript drafting. AG, BM, RGHN, EBC, and AL contributed to the study conception and design, interpretation of findings, and critical revision of the manuscript, with AG serving as the corresponding author. All authors reviewed and approved the final version of the manuscript and accept responsibility for the integrity and accuracy of the work.

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CONFLICT OF ONTEREST

None.

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