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The Application of Social Cognitive Theory on Tertiary Preventive Behavior in Elderly with Type 2 Diabetes Mellitus: A Multilevel Analysis

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ABSTRACT

Background: Diabetes Mellitus is a chronic disease whose prevalence increases, especially in old age. About a quarter of people over the age of 65 suffer from diabetes. DM can cause serious complications up to death. The importance of tertiary preventive behavior to prevent complications. This study aimed to analyze the influence of the Social Cognitive Theory construct and the contextual influence of posyandu on the tertiary preventive behavior of elderly people with type 2 diabetes mellitus.
Subjects and Method: A cross-sectional study was conducted at 25 integrated health posts (posyandu) in Magetan, East Java, Indonesia, from April to May 2024. 200 elderly with type 2 DM were selected by stratified random sampling. The dependent variable was tertiary preventive behavior. The independent variables were self-regulation, knowledge, expectations, self-efficacy, reinforcement, and observational learning. Data collection was carried out by interviews and questionnaires. The data were analyzed using a multiple multilevel linear regression.
Results: Tertiary preventive behavior was higher in self-regulation (b= 0.24; 95% CI= 0.01 to 0.46; p= 0.038), knowledge (b= 0.70; 95% CI= 0.23 to 1.17; p= 0.003), expectations (b= 0.53; 95% CI= 0.35 to 0.71; p <0.001), self-efficacy (b= 0.39; 95% CI= 0.11 to 0.67; p= 0.006), reinforcement (b= 1.26; 95% CI= 0.90 to 1.62; p<0.001), and observational learning (b= 0.30; 95% CI= 0.01 to 0.59; p= 0.036). There were no significant relationships of age and gender on tertiary preventive behavior. There was a contextual effect of elderly *posyandu* on tertiary preventive behavior (ICC= 6.39%).
Conclusion: Tertiary preventive behavior is higher in self-regulation, knowledge, expectations, self-efficacy, reinforcement, and observational learning. There are no significant relationships of age and gender on tertiary preventive behavior. There is a contextual effect of elderly *posyandu* on tertiary preventive behavior.

Keywords: social cognitive theory, tertiary preventive behavior, diabetes mellitus, elderly.

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BACKGROUND

Diabetes is an important health problem among the elderly, with approximately a quarter of individuals over the age of 65 years old suffering from diabetes and half of the elderly adult population having pre-diabetes. Elderly people who suffer from diabetes have a higher risk of premature death, functional disability, and comorbidities such as hypertension, coronary heart disease, and stroke than those who do not have diabetes (ADA, 2018).

The prevalence of type 2 diabetes mellitus in individuals aged 65 years and over increased from 18.4% to 24.6%, while in the younger age group, the increase was from 8.8% to 11.7%. It is estimated that the prevalence of diabetes will continue to increase as the population ages, reaching 19.9% or around 111.2 million people aged 65 to 79 years. Projections show that this figure continues to increase, estimated to reach 578 million in 2030 and even 700 million in 2045 (Indonesian Ministry of Health, 2020).

In developing countries such as Asia, it is the main source of the diabetes mellitus epidemic and contributes to >60% of the global burden of diabetes mellitus (Chauhan et al., 2022). There are several people who suffer from diabetes without a diagnosis, 1 in every 9 adults in Indonesia experiences a chronic metabolic disorder characterized by high blood sugar levels. An even more surprising fact is that during 2021, the number of deaths due to diabetes in Indonesia has reached 236,711 cases. This highlights the importance of awareness of how serious a threat of this disease is to public health (IDF, 2021).

The prevalence of diabetes in residents in East Java aged over 15 years has increased by 0.5% in the period between 2013 and 2018, increasing from 2.1% to 2.6%. In addition, the data also shows that the prevalence rate of diabetes in women (1.7%) is significantly higher than in men (1.4%). According to information obtained from the Magetan District Health Service in 2021, there were a significant number of 18,794 cases of diabetes sufferers in Magetan District.

Diabetes mellitus sufferers are at high risk of experiencing serious side effects such as retina damage, peripheral neuropathy, heart attacks, peripheral vascular disorders, end-stage kidney disease, and ulcers and even leg amputation (Da & Kar, 2023). This complication occurs when blood sugar levels are not well controlled and can cause significant damage (Yari et al., 2023).

Diabetes mellitus prevention consists of three levels, namely primary prevention which aims to prevent the emergence of DM in individuals who have not experienced it but have risk factors. Primary prevention is by carrying out management and education actions for high risk groups. Secondary prevention is screening risk groups (Valabhji et al., 2020).

Tertiary prevention is taking action on DM patients to prevent complications and more severe negative impacts on individuals with diabetes mellitus. Tertiary prevention efforts include blood sugar management, healthy eating patterns, regular physical activity, and controlling blood pressure (Yari et al., 2023).

Regular physical activity has various benefits, including helping to control blood sugar levels, increasing insulin sensitivity, and maintaining a healthy heart and blood vessels. By integrating this behavior into daily lifestyle, people can improve their quality of life (Francis, 2019).

Social cognitive theory is quite relevant to explain the phenomenon of tertiary preventive behavior in elderly people with diabetes mellitus. In this context, tertiary

prevention approaches play a key role, focusing on preventing further complications and slowing disease progression in individuals who have been diagnosed with diabetes mellitus. This theory emphasizes that cognitive processes involve managing complex health conditions. Social cognitive theory directs attention to increasing knowledge, self-efficacy and skills to encourage tertiary preventive behavior, so this theory is considered to be able to explain the phenomenon of tertiary preventive behavior, especially in the elderly. (Ghoreishi et al., 2019).

Social Cognitive Theory also functions in understanding tertiary preventive behavior in elderly people with diabetes mellitus because it can explain how individuals develop and maintain behavior to prevent disease complications. In the context of elderly people with diabetes mellitus, this theory helps in understanding how self-confidence, outcome expectations, and learning from the experiences of other people and the surrounding environment can influence the implementation and maintenance of healthy behaviors such as appropriate eating patterns, blood sugar management, levels and adherence to treatment. which is being done. (Shamizadeh et al., 2019).

Based on the phenomena found, this study aimed to analyze the influence of social cognitive theory constructs and the contextual influence of posyandu on the tertiary preventive behavior of elderly with type 2 diabetes mellitus.

SUBJECTS AND METHOD

1. Study Design

A quantitative research with analytical observational methods with cross-sectional studies. This research was conducted in the Magetan Regency area. This research was conducted in April-May 2024.

2. Population and Sample

The population in this study were elderly with type 2 diabetes mellitus in the Magetan Regency area. The number of integrated health center used in the research was 25 elderly posyandu. Each integrated health center consisted of 8 subjects suffering from type 2 DM. The sampling technique was stratified random sampling.

3. Study Variables

The dependent variable was tertiary preventive behavior. The independent variables were self-regulation, knowledge, expectations, self-efficacy, reinforcement, and observational learning.

4. Operational Definition of Variables

Tertiary Preventive Behavior: actions aimed at preventing further complications, slowing disease progression, and improving the quality of life for individuals who are already experiencing a chronic disease or condition. Data was taken using a questionnaire with a continuous scale.

Self-regulation: an individual's ability to control his/her emotions, thoughts, and behavior to achieve long-term goals. This includes the ability to manage stress, resist urges, and motivate oneself. Data was taken using a questionnaire with a continuous scale.

Knowledge: information and skills acquired through experience, education, or learning. It includes an understanding of the facts, concepts, and principles that enable individuals to recognize health risks and benefits. Data was taken using a questionnaire with a continuous scale.

Expectation: refers to the beliefs a person has about the outcomes or consequences that may occur as a result of the behavior they undertake. Data was taken using a questionnaire with a continuous scale.

Self-efficacy: a person's belief in his or her ability to complete a task or achieve a

particular goal. Data was taken using a questionnaire with a continuous scale.

Reinforcement: a strategy that involves using incentives to provide consequences that increase the likelihood that a particular behavior will be repeated in the future. Data was taken using a questionnaire with a continuous scale.

Observational learning: the process of learning by observing and imitating the behavior of others. Data was taken using a questionnaire with a continuous scale.

5. Study Instruments

The research instrument used for data collection is using questionnaires.

6. Data analysis

Univariate analysis was conducted to determine the frequency distribution and percentage of each variable examined in the study. Bivariate analysis was then performed to assess the relationship between the independent variables of social cognitive theory constructs and the dependent variable (tertiary preventive behavior). A multivariate analysis was carried out using a linear regression model with a multilevel approach to identify the most influential factors and account for hierarchical data structures.

7. Research Ethics

Research ethics including informed consent, anonymity, and confidentiality, were handled carefully throughout the research process. A letter of approval was obtained from the Research Ethics Committee of Dr. Moewardi Hospital Surakarta on March 26 2024 with number 832/III/HREC/2.

RESULTS

1. Sample Characteristics

Table 1 presents the distribution of participants' characteristics. The study involved 200 elderly individuals with type 2 diabetes mellitus. Based on gender, 33 participants (16.5%) were male, and 167 (83.5%) were female. Regarding age, 94 participants (47%) were under 66 years old, while 106 participants (53%) were aged 66 years or older. In terms of education level, 37 participants (18.5%) had completed elementary school, 80 (40%) had a junior high school education, 69 (34.5%) had completed high school, and 14 (7%) had attained college-level education. For employment status, 83 participants (41.5%) were housewives, 99 (49.5%) were farmers or businesspeople, and 18 (9%) were retirees.

Table 1. Frequency distribution of respondent characteristics (categorical data)

Variables	Category	Frequency (n)	Percentage (%)
Gender	Male	33	16.5
	Female	162	83.5
Age (years old)	<66 years old	94	47
	≥66 years old	106	53
Educational Level	Elementary School	37	18.5
	Middle School	80	40
	High School	69	34.5
	College	14	7
Employment	Housewives	83	41.5
	Farmers/Businessman	99	49.5
	Retired	18	9

2. Bivariate analysis

Table 2 shows an analysis of the direct influence between variables which include self-regulation, knowledge, expectations, self-efficacy, reinforcement, observational learning, and tertiary preventive behavior.

a. Self-Regulation on tertiary preventive behavior

Self-regulation has a positive and statistically significant relationship with tertiary preventive behavior in elderly. Every 1 unit increase in self-regulation score will be followed by an increase in tertiary preven-9tive behavior by 0.24 units (b = 0.24; 95% CI = 0.01 to 0.46; p = 0.038).

b. Knowledge on tertiary preventive behavior

Knowledge has a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in knowledge score will be followed by an increase in tertiary preventive behavior by 0.70 units (b= 0.70; 95% CI= 0.23 to 1.17; p= 0.003).

c. Outcome expectation on tertiary preventive behavior

Expectation has a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in expectancy score will be followed by an increase in tertiary preventive behavior by 0.53 units (b= 0.53; 95% CI= 0.35 to 0.71; p<0.001).

d. Self-Efficacy on tertiary preventive behavior

Self-efficacy has a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in self-efficacy score will be followed by an increase in tertiary preventive behavior by 0.39 units (b= 0.39; 95% CI= 0.11 to 0.67; p= 0.006).

e. Reinforcement on tertiary preventive behavior

Reinforcement has a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in reinforcement score will be followed by an increase in tertiary preventive behavior of 1.26 units (b= 1.36; 95% CI= 0.90 to 1.62; p< 0.001).

f. Observational learning on tertiary preventive behavior

Observational learning has a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in observational learning score will be followed by an increase in tertiary preventive behavior of 0.30 unit (b= 0.30; CI 95%= 0.01 to 0.59; p = 0.036).

Table 2. Results of bivariate analysis of factors related to tertiary preventive behavior in the elderly with T2DM

Independent Variable	Regression coefficient (b)	CI 95%		p
		Lower Limit	Upper Limit	
Self-regulation	0.24	0.01	0.46	0.038
Knowledge	0.70	0.23	1.17	0.003
Expectation	0.53	0.35	0.71	<0.001
Self-efficacy	0.39	0.11	0.67	0.006
Reinforcement	1.26	0.90	1.62	<0.001
Observational learning	0.30	0.01	0.59	0.036

3. Multivariate analysis

Table 3 shows the results of multivariate analysis where this study used multiple linear regression with a multilevel approach on the variables of self-regulation, knowledge, expectations, self-efficacy, reinforce-

ment, observational learning, and tertiary preventive behavior with a multilevel approach. Level I called the individual level and level II is the elderly integrated health center level.

a. Self-Regulation on tertiary preventive behavior

Self-regulation can directly influence tertiary preventive behavior. Self-regulation has a positive and statistically significant relationship with tertiary preventive behavior in elderly. Every 1 unit increase in self-regulation score will be followed by an increase in tertiary preventive behavior of 0.24 units (b= 0.24; 95% CI= 0.01 to 0.46; p= 0.038). So it can be concluded that individuals with strong regulation have the ability to carry out tertiary preventive behavior by 0.24 units higher than individuals with weak regulation.

b. Knowledge on tertiary preventive behavior

Knowledge has a role in influencing tertiary preventive behavior. Knowledge has a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in knowledge score will be followed by an increase in tertiary preventive behavior of 0.70 units (b= 0.70; 95% CI= 0.23 to 1.17; p = 0.003).

c. Expectation on tertiary preventive behavior

Expectations can influence tertiary preventive behavior. Expectations have a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in expectancy score will be followed by an increase in tertiary preventive behavior of 0.53 units (b= 0.53; 95% CI= 0.35 to 0.71; p<0.001).

d. Self-Efficacy on tertiary preventive behavior

Self-efficacy can directly influence tertiary preventive behavior. Self-efficacy has a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in self-efficacy score will be followed by an increase in tertiary preventive behavior of 0.39 units (b= 0.39; 95% CI= 0.11 to 0.67; p= 0.006).

e. Reinforcement on tertiary preventive behavior

Reinforcement has a role in influencing tertiary preventive behavior. Reinforcement has a positive and statistically significant relationship with tertiary preventive behavior. Every 1 unit increase in reinforcement score will be followed by an increase in tertiary preventive behavior of 1.26 units (b= 1.36; 95% CI= 0.90 to 1.62; p<0.001).

f. Observational learning on tertiary preventive behavior

Observational learning can influence tertiary preventive behavior. Observational Learning has a positive and statistically significant relationship to tertiary preventive behavior. Every 1 unit increase in observational learning scores will be followed by an increase in tertiary preventive behavior of 0.30 units (b= 0.30; 95% CI= 0.01 to 0.59; p= 0.036).

g. Age on tertiary preventive behavior

There was a positive relationship between age and positive preventive behavior, but it was not statistically significant. Every 1 year increase in age will be followed by a decrease in tertiary preventive behavior of 0.03 units (b= 0.03; 95% CI= -0.05 to 0.11; p= 0.448). Based on the results of the analysis, it was found that age had no influence on tertiary preventive behavior (p>0.050).

h. Gender on tertiary preventive behavior

Tertiary preventive behavior between male and female elderly patients, however, was not statistically significant. Female elderly patients on average had a tertiary preventive behavior score by -0.57 units lower than men (b=-0.57; 95% CI = -1.77 to 0.62;

p= 0.348). Based on the results of the analysis, it was found that gender had no influence on tertiary preventive behavior (p>0.050).

i. Integrated health center contextual on tertiary preventive behavior

Multilevel multiple linear regression model analysis applied to integrated health center contextual variables showed low suitability, with an Intraclass Correlation Coefficient (ICC) value of 6.39%. This means that only around 6.39% of the variation in tertiary preventive behavior can be explained by contextual factors at the elderly integrated health center contextual level. The influence of these contextual factors is considered statistically insignificant because this value is below the minimum threshold for the influence of contextual factors, namely <8-10%. Therefore, it can be concluded that integrated health center contextual contextual factors have a low contribution in explaining variations in tertiary preventive behavior among elderly people with type 2 diabetes mellitus.

Table 4. Results of multilevel multiple linear regression analysis on social cognitive theory with tertiary preventive behavior among elderly with type 2 DM

Independent Variable	Regression coefficient (b)	95% CI		p
		Lower Limit	Upper Limit	
Fixed effect				
Self-regulation	0.24	0.01	0.46	0.038
Knowledge	0.70	0.23	1.17	0.003
Expectation	0.53	0.35	0.71	<0.001
Self-efficacy	0.39	0.11	0.67	0.006
Reinforcement	1.26	0.90	1.62	<0.001
Observational learning	0.30	0.01	0.59	0.036
Age (years old)	0.03	-0.05	0.11	0.448
Gender (female)	-0.57	-1.77	0.65	0.348
Random effect				
Posyandu				
Var (constant)	0.57	0.10	3.20	
N observation = 200				
Group Average = 8,				
min = 8, max = 8				
Log likelihood = -503.03				
p<0.001				
ICC = 6.39%				

DISCUSSION

Tertiary preventive behavior among elderly with type 2 DM is influenced by the individual's self-regulation. The results of this study show that there is a positive and statistically significant relationship where every 1 unit increase in self-regulation score will be followed by an increase in tertiary preventive behavior of 0.24 units (b= 0.24; 95% CI= 0.01 to 0.46; p= 0.038). It can be concluded that elderly people with type 2 DM with strong self-regulation have the ability to carry out tertiary preventive behavior.

In line with research conducted by Yari et al., (2023) which stated that self-regulation through targeted interventions can help individuals be more effective in managing their health, especially in implementing tertiary preventive measures.

Strong self-regulation can help individuals overcome obstacles and challenges in maintaining their health. With good self-regulation, elderly people are better able to motivate themselves to be involved in making better decisions to remain consistent in carrying out tertiary preventive actions, such as complying with medication, maintaining a healthy diet, and exercising regularly (Mikhael et al., 2020).

Knowledge directly influences tertiary preventive behavior in elderly people with type 2 DM which is statistically significant. It is shown that an increase of 1 unit in knowledge score will be followed by an increase in tertiary preventive behavior of 0.70 units (b= 0.70; 95% CI= 0.23 to 1.17; p= 0.003). It means that with good knowledge, people will have the ability to carry out tertiary preventive actions.

The research results are in line with research conducted by Chai et al. (2018) that someone who has a deep understanding of health is able to reduce the risk or prevent disease. Actions that are based on health knowledge tend to be more consistent and sustainable compared to actions that are not based on this understanding. The more knowledge a person has about DM, the more effective they will be in carrying out appropriate preventive behaviors for DM.

Other research explains that a good understanding of health encourages consistent and sustainable preventive behavior. For example, people who understand the importance of regular checkups, appropriate treatment, and a healthy lifestyle are more likely to follow the necessary treatment plan to prevent complications. This knowledge helps them make decisions about preventive behavior (Yuliana et al., 2020).

Expectations explain that there is a positive and statistically significant relationship between expectations and tertiary preventive behavior. Every 1 unit increase in expectancy score will be followed by an increase in tertiary preventive behavior of 0.53 units (b= 0.53; 95% CI= 0.35 to 0.71; p<0.001). Therefore, it can be concluded that good expectations will encourage individuals to carry out tertiary preventive behavior.

This study is in line with research by Sebastian et al. (2021) showing that outcome expectations, which are part of social cognitive theory, have a significant positive correlation with preventive behavior. These outcome expectations also play an important role in helping to achieve goals. When people have positive expectations about the outcomes of preventive actions, they are more motivated to set and achieve health goals that support those preventive behaviors (Ghoreishi et al., 2019).

Self-efficacy in this study has a positive and statistically significant relationship between self-efficacy and tertiary preventive behavior. Every 1 unit increase in self-efficacy score will be followed by an increase in tertiary preventive behavior by 0.39 units (b= 0.39; 95% CI= 0.11 to 0.67; p = 0.006). So, it can be concluded that with strong self-efficacy, people will have the ability to carry out tertiary preventive behavior.

This is in line with research by Smith et al., (2020) which stated that with social cognitive theory interventions, one of which is patient self-efficacy which is very important in improving their tertiary preventive behavior. By increasing patients' confidence in their ability to undergo preventive measures, it can help elderly patients with DM more consistently follow treatment plans (Yari et al., 2023). Other research explains that self-efficacy refers to a person's belief in their ability to carry out healthy behavior. These beliefs play an important role in

their motivation and actions to maintain health (Kurnia et al., 2017).

Reinforcement in this study has a positive and statistically significant relationship between reinforcement and tertiary preventive behavior. Every 1unit increase in reinforcement score will be followed by an increase in tertiary preventive behavior by 1.26 units (b= 1.26; 95% CI = 0.90 to 1.62; p<0.001). It can be concluded that with high reinforcement, people will have the ability to carry out tertiary preventive behavior.

In line with research (Yuliana et al., 2020) reinforcement, such as giving appreciation, plays an important role in influencing preventive behavior. When patients feel valued and supported, they are more motivated to increase patient compliance with necessary preventive measures.

Observational learning has a positive and statistically significant relationship between tertiary preventive behavior, where every 1 unit increase in observational learning score will be followed by an increase in tertiary preventive behavior of 0.30 units (b = 0.30; 95% CI= 0.01 to 0.59; p= 0.036). So, it can be concluded that with strong observational learning, people will have the ability to carry out tertiary preventive behavior.

In line with research conducted by Yari et al. (2023), the results show that observational learning based on social cognitive theory influences educational interventions in health promotion in the preventive behavior of diabetes patients. Thojampa & Sarnkhaowkhom (2019) explain that when someone with diabetes mellitus sees good improvement in a particular behavior, they may be motivated to imitate that behavior in the hope of success, according to the decision they take.

The results of the multilevel multiple linear regression analysis on the contextual posyandu, obtained ICC= 6.39%. This means that only 6.39% of the variation in tertiary preventive behavior is determined by contextual factors at the elderly integrated health center level. The influence of these contextual factors is not statistically significant because it is lower than 8-10% as the minimum threshold value for the influence of contextual factors.

Integrated health center for the elderly aims to improve the health of elderly people with diabetes mellitus through direct access, information, social support and increasing awareness (Francisco et al., 2018). Although posyandu with good services are available, not all elderly people use them due to unawareness and lack of motivation. Factors such as personal beliefs, risk perception, and self-motivation influence prevention behavior more than access or quality of services. Low environmental support also hinders the optimization of preventive behavior (Liese et al., 2019).

AUTHOR CONTRIBUTION

All authors have made significant contributions to data analysis as well as preparing the final manuscript.

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This study is self-funded.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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