Analysis of self-regulation model to improvement of self-care capability in type 2 Diabetes Mellitus patients

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Abstract: The importance of maintaining controlled blood glucose and preventing complications in individuals with type 2 Diabetes Mellitus (DM) hinges significantly on self-care practices. A contributing factor to insufficient self-care, impacting quality of life, is the inadequate execution of self-regulation. This research aims to formulate a self-regulation model, grounded in individual and family self-management theory, to enhance self-care among individuals with type 2 DM. Employing a quantitative approach through cross-sectional methods, this study involved a sample of 115 type 2 DM patients in Sidenreng Rappang City. Structural Equation Modeling-Partial Least Squares (SEM-PLS) served as the analytical method. The findings revealed that the self-regulation process among T2DM patients significantly influences their ability to engage in self-care. The interpretation of the illness directly affects the coping mechanisms and emotional responses of those affected. Both the interpretation of the disease and emotional responses play pivotal roles in shaping coping mechanisms. Furthermore, it was established that interpretations are influenced by individual factors, disease representations, environmental factors, and family support. The self-regulation process is formed by coping mechanisms that, in turn, significantly impact the self-care practices of individuals dealing with type 2 Diabetes Mellitus (DM) while addressing their health concerns.

Keywords: self-regulation model, self-care, type 2 Diabetes Mellitus

1. Introduction

Efforts to control blood sugar in DM sufferers are needed to prevent uncontrolled increases in blood sugar and avoid complications. This is because DM has a large role in increasing the morbidity and mortality rates of the population (Hidayat et al., 2022). Globally, the prevalence of diabetes mellitus (DM) has continued to increase over the years. The significant increase in prevalence mainly occurred in low- and middle-income countries (IDF, 2019). Self-care for people with type 2 diabetes mellitus (DM) is very important to maintain controlled blood glucose and prevent complications (Pereira et al., 2020; Fadli et al., 2023).

The ability to perform self-care in patients with type 2 DM is still relatively low (Noviyanti et al., 2021). This is characterized by failure to control blood glucose caused by noncompliance with medication, diet and lifestyle, thus affecting the increasing prevalence and complications of diabetes mellitus (Hidayat et al., 2022). Self-care is one of the main components in managing diabetes, and thus far, it has been carried out by patients but has not been optimal, including managing diet, physical activity, health control/checks, and ability to care for feet (Goins et al., 2020), as well as stress management (Castillo et al., 2022).

Research from China shows that there is self-care adherence of diabetes patients in the moderate category (50.4%) and low category (33.6%) (Qi et al., 2021). Control of blood sugar levels is also still relatively low at 43.3% (Asnani & Munir, 2020). The results of other studies also support this research that there is a self-care inability to monitor blood sugar of 62.6% (Kurniawan et al., 2020). Based on the literature review, there are still type 2 DM patients who do not know how to manage diabetes self-care in depth and correctly, thereby affecting their health status and quality of life. Decreased quality of life is caused by the inability of DM sufferers to carry out self-care independently (Hsu et al., 2018). One of the factors causing low self-care, which has an impact on quality of life, is the inability to carry out self-regulation well (Putri, 2017; Estuningsih et al., 2019).

The results of the research show that self-regulation of diabetes mellitus patients is still relatively low for the dimensions of identity (45.5%) and cause (72.3%), which describes the patient’s understanding of the causes and symptoms...
of the disease is not correct, so they do not have effective coping (Putri, 2017). Self-regulation provides direction and goals to be achieved as well as ways to achieve these goals (Castonguay et al., 2018). Regarding self-regulation behavior, there are factors that can support a person's self-regulation, namely, social support and health services (Nursalam et al., 2020). Self-regulation has an influence on glycemic control, dietary behavior and lifestyle, which are key to treating type 2 DM (Hariyono & Romli, 2020).

Increased self-regulation of DM patients can be improved through a family approach. According to the theory of individual and family self-management (IFSMT), the process of changing behavior in sufferers as individuals and families through health education includes self-management processes, proximal outcomes, and distal outcomes (Ryan and Sawin, 2009). Several research results show that self-regulation can improve a person's self-care behavior in adopting a healthy lifestyle (Hariyono and Romli, 2020; Chuman and Hatamochi, 2021; lawchud, Rojpaisarnkit and Imami, 2023). However, the self-regulation of DM patients has not been able to show an increase in self-care abilities that are good at improving quality of life. Thus, in this study, the IFSMT factor is important to be integrated into the self-regulation of DM patients in the hope that it will improve their self-care abilities and improve their quality of life. The purpose of this research is to develop a self-regulation model based on individual and family self-management theory to improve self-care in type 2 DM sufferers.

2. Materials and Methods

The design of this research is a cross-sectional study, and data were collected from the Health Center in Sidrap Regency from May to August 2023. The research objective prepared by the researcher was to confirm the research hypothesis. The study was conducted on type 2 DM patients who had blood glucose >210 mg/dl, a total of 115 people from a population of 237 people suffering from type 2 diabetes mellitus. Sampling was performed using a multistage random sampling technique with the sample criteria being that the patient was >35 years old, had a level of self-dependence, and were not currently undergoing treatment in the hospital.

These research variables include endogenous variables and exogenous variables. Endogenous variables consist of coping and self-care, while exogenous variables consist of individual factors, disease representation, environmental factors, family factors, emotional responses, disease interpretation, and self-management processes. Questionnaires on individual factors include indicators of sex, age, history of disease, length of illness, and complications (Karami et al., 2021). The disease representation questionnaire was modified from an identification scale, causes, timelines, consequences, and disease control (Putri et al., 2017). This environmental factor uses a questionnaire from indicators of the physical environment and social environment (Monebadi et al, 2018). The family factor questionnaire consists of indicators of family development stage, family cognition, family support, family structure, and health literacy (Hidayat et al. 2019). The modified emotional response questionnaire from the Depression Anxiety Stress Scale (DASS 42) has indicators including fear, anxiety and depression (Estuningsih et al, 2019). The problem interpretation questionnaire was modified from a disease perception scale with indicators including symptoms, treatment and causes of disease (Vosh et al, 2011). In the self-management process questionnaire developed from individual and family self-management theoretical models consisting of indicators of knowledge, beliefs, skills, and social facilities (Ryan and Sawin, 2009). The coping questionnaire has been modified from theCOPE Inventory scale with indicators focusing on problems and focusing on the patient's emotions (Nursalam et al., 2020). For the self-care questionnaire, the results of the modified Summary of Diabetes Self-Care Activity (SDSCA) questionnaire include diet, physical activity, medication, blood sugar control, and diabetic foot care. Measurement of blood sugar levels using a digital glucometer.

The stage in this research is questionnaire development, and all questionnaires have been tested for validity and reliability. The validity test of the questionnaire used is the average variance extracted (AVE) value, and the results show that all variables are valid and strong in decision making for the modeling structure. The next stage is collecting data such as explaining the research objectives, benefits and research procedures and providing information to respondents. Data analysis was conducted using structural equation modeling-partial least squares (SEM - PLS) to examine the effect of exogenous variables on endogenous variables according to the objectives of the study, such as the outer model, inner model, and weight relation. Thus, this research met the requirements of research ethics through the research ethics of the Faculty of Health, University of Mega Buana Palopo, Indonesia. The study protocol was approved by the Health Research Ethics Committee of the Faculty of Health, University of Mega Buana Palopo, Indonesia.

3. Results

Tables 1 shows that the majority of women have type 2 diabetes and often do not have complications such as hypertension or stroke. The DM type 2 patient's median age was presenile, and her median duration of type 2 diabetes was 4 years and 8 months. On the other hand, when they were still in the abnormal category, their blood glucose averaged 265.2 mg/dl.

The results of the composite reliability value and R-square value can be explained in Tables 2, which shows that the value is greater than 0.70. These results show that the measurements for each variable are consistent, and the test results
for the structural model measurement, including convergent validity, discriminant validity and composite reliability tests, show good results except for the disease presentation variable, which is 0.382.

Figures 1 shows that the process of self-regulation is formed by coping, which can affect the self-care of type 2 DM patients in overcoming their disease problems. Interpretation of disease problems is part of self-regulation formed by individual factors, disease representation, environmental factors, and family support. Thus, interpretation does not directly affect emotional responses but affects coping. In addition to the interpretation of the problem of illness, emotional responses also affect coping directly. Therefore, in the final results of the model, it was found that coping results influenced increased self-care in type 2 DM patients.

Table 1 Distribution Characteristics of Respondents (n=115).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean±SD</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>-</td>
<td>40 (34.8)</td>
</tr>
<tr>
<td>Female</td>
<td>-</td>
<td>75 (65.2)</td>
</tr>
<tr>
<td>Disease Complications, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No complications</td>
<td>-</td>
<td>51 (44.3)</td>
</tr>
<tr>
<td>There are complications</td>
<td>-</td>
<td>64 (55.7)</td>
</tr>
<tr>
<td>Ages, Years (±Up to)</td>
<td>56.2±6.21</td>
<td>-</td>
</tr>
<tr>
<td>Long suffering from DM, years (±Up to)</td>
<td>4.8±3.60</td>
<td>-</td>
</tr>
<tr>
<td>Blood sugar while mg/dL (±Up to)</td>
<td>265.2±45.06</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2 Results of the Structural Measurement Model Test.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Composite Reliability</th>
<th>R-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Factors</td>
<td>0.744</td>
<td>0.640</td>
</tr>
<tr>
<td>Disease Representation</td>
<td>0.382</td>
<td>0.020</td>
</tr>
<tr>
<td>Environmental factor</td>
<td>0.937</td>
<td>0.866</td>
</tr>
<tr>
<td>Family Factor</td>
<td>0.936</td>
<td>0.914</td>
</tr>
<tr>
<td>Emotional Reaction</td>
<td>0.728</td>
<td>0.459</td>
</tr>
<tr>
<td>Problem Interpretation</td>
<td>0.926</td>
<td>0.879</td>
</tr>
<tr>
<td>Process Self-Management</td>
<td>0.939</td>
<td>0.911</td>
</tr>
<tr>
<td>Coping</td>
<td>0.921</td>
<td>0.830</td>
</tr>
<tr>
<td>Self-Care</td>
<td>0.977</td>
<td>0.970</td>
</tr>
</tbody>
</table>

Figures 1 Structure of Self-Regulation Model to Improvement of Self-care in Type 2 DM Patients.

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4. Discussion

Self-regulation is one of the factors causing a patient’s low self-care ability (Nursalam et al., 2020). Therefore, to be able to manage the disease effectively, a self-regulation model approach is needed to control the emotions and self-concept of type 2 DM patients. An individual must have strong self-regulation abilities to regulate their emotions, thoughts or behavior. A lack of self-regulatory strength can cause individuals to fail to make behavioral changes (Mosleh et al., 2017; Papachristoforou et al., 2020). Self-regulation has an influence on glycemic control, dietary behavior and lifestyle, which are key to managing type 2 diabetes mellitus (Hariyono and Romli, 2020).

Self-care of type 2 DM patients is very important to maintain controlled blood glucose and prevent complications (Pereira et al., 2020). The self-care ability of type 2 diabetes mellitus patients is influenced by several factors, including knowledge, education level, self-esteem, social support, self-efficacy, and disease perception/interpretation of problems (Momenabadi et al., 2020; Putra et al., 2019). The results of this study show that the interpretation of disease problems, which are part of self-regulation, is formed by individual factors, disease representation, environmental factors, and family support. Thus, problem interpretation directly influences coping, which has an impact on increasing the self-care ability of type 2 DM patients. These results show that the measurements for each variable are consistent, and the test results for the structural model measurement, including convergent validity, discriminant validity and composite reliability tests, show good results except for the disease presentation variable, which is 0.382. Problem interpretation is the stage where individual perceptions emerge due to stimuli or health threats that are influenced by individual factors (Ogden, 2007).

The interpretation of patient problems in the results of this study regarding aspects of symptom indicators, treatment and causes of type 2 DM are greatly influenced by social support from family and health workers. However, its most important role is the support of health workers. Good family support will improve the patient’s interpretation of the disease (Goldstein et al., 2018; Pace et al., 2018). This is in line with previous research that shows that good family support and increasing patient knowledge will increase self-care behavior (Fahamsya, Anggraini and Faizin, 2022; Uly et al., 2023). The role of type 2 diabetes mellitus patients in fulfilling self-care is very important to prevent self-care deficits, so self-care is needed to meet the needs and improve the quality of life of type 2 diabetes mellitus patients (Alligood, 2014). One of the factors causing low self-care, which has an impact on quality of life, is the inability to conduct self-regulation well (Putri, 2017; Estuningsih et al., 2019). The process of self-regulation involves coping, which can affect the self-care of type 2 DM patients in overcoming their disease problems. Interpretation of disease problems is part of self-regulation formed by individual factors, disease representation, environmental factors, and family support. Thus, interpretation does not directly affect emotional responses but affects coping. In addition to the interpretation of the problem of illness, emotional responses also affect coping directly. Therefore, in the final results of the model, it was found that coping results influenced increased self-care in type 2 DM patients.

Findings from several previous studies only explain the effect of self-regulation models on self-care management (Hariyono and Romli, 2020; Sari, 2020; Chuman and Hatamochi, 2021; lawchud, Rojpaisarnkit and Imami, 2023). Therefore, this research has the advantage that to process self-regulatory behavior, it not only requires intention from within the patient but also requires knowledge, self-efficacy, and social facilities that will influence the patient to change. In addition, it can reflect the values and beliefs of individuals and families in preventing disease or facilitating the management of complex health management. This research also touches on self-regulation in individuals and families, and this may occur in collaboration with health professionals. In addition, it also describes the refinement of health behavior change, self-regulation theory, social support theory, and research related to chronic disease self-management.

4. Conclusions

In the final modeling results, it was found that coping results influenced self-care improvement in type 2 DM patients. Therefore, the model in this study is that the self-regulation process is formed by coping, which can influence the self-care of type 2 diabetes mellitus (DM) patients in solving their disease problems. The interpretation of disease problems, which are part of self-regulation, is shaped by individual factors, disease representations, environmental factors, and family support. Thus, interpretation does not directly affect emotional response, but it influences coping. Apart from interpreting disease problems, emotional responses also directly influence coping.

The implication of this study is that strengthening health workers is needed to increase patient confidence in solving health problems so that patients are able to set goals and take appropriate actions expected to increase their awareness in performing self-care. This will have an impact on controlling blood sugar levels and preventing disease complications.

Ethical considerations

This research was approved by the Ethics Committee of Mega Buana University, protocol number 003/UMBP/EC/IV/2023, and took into account the principles of the research process.

Conflict of Interest
The authors declare no conflicts of interest.

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