Kesmas

Volume 18
Issue 1 *February*

Article 3

2-28-2023

# Information-Motivation-Behavioral Skill in Diabetes Self-management Using Structural Equation Modeling Analysis

Dien Kurtanty
*Department of Public Health Studies, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia*, dienkurtanty@gmail.com

Adang Bachtiar
*Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia*, adangkantaadmadja@gmail.com

Cicilya Candi
*Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia*, abteam.fkmui@gmail.com

Alya Pramesti
*Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia*, alyapramestin@gmail.com

Almira Fanny Rahmasari
*Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia*, almirafanny18@gmail.com



## Recommended Citation

Kurtanty D , Bachtiar A , Candi C , et al. Information-Motivation-Behavioral Skill in Diabetes Self-management Using Structural Equation Modeling Analysis. *Kesmas*. 2023; 18(1): 16-23
DOI: 10.21109/kesmas.v18i1.6255
Available at: https://scholarhub.ui.ac.id/kesmas/vol18/iss1/3

Kurtanty, *et al. Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*. 2023; 18 (1): 16-23
DOI: 10.21109/kesmas.v18i1.6255

**Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)**

# Information-Motivation-Behavioral Skill in Diabetes Self-management Using Structural Equation Modeling Analysis

**Dien Kurtanty[1], Adang Bachtiar[2], Cicilya Candi[2], Alya Pramesti[2], Almira Fanny Rahmasari[2*]**

[1]Department of of Public Health Studies, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia, [2]Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia

**Abstract**

Diabetes is the "mother" of various diseases increasing the risk of morbidity and mortality. Diabetes self-management, an effort made by patients to control blood sugar levels, is an important part of the management strategy. Therefore, this study analyzed information, motivation, and behavioral skills associated with diabetes self-management. Data were collected in the Special Capital Region of Jakarta, with 277 diabetic patients selected using a questionnaire by a systematic random sampling method. The analyzed variables were information (with indicator variables of information on physical activity, nutritional intake, drug consumption, and blood sugar monitoring); sociodemographic (age, sex, occupation, education level, and duration of diabetes); motivation (barrier, benefit, self-efficacy, severity, and susceptibility); and behavioral skills (new motor, self-regulatory, and social skills), which were analyzed to identify their influence on diabetes self-management using structural equation modeling. The results indicated that information and motivation significantly and positively affected behavioral skills; while, sociodemographic did not. Behavioral skills had a significant and positive effect on diabetes self-management. Accordingly, people with diabetes information, motivation, and behavioral skills need to be improved to increase the success of diabetes self-management.

**Keywords**: diabetes, diabetes self-management, structural equation modeling

## Introduction

Diabetes is a disease that can be the main cause of blindness, heart disease, kidney failure, and premature death. According to the 2019 International Diabetes Federation (IDF) data, there were 463 million people worldwide, or 9.3% of the population, aged 20–79 years, who had diabetes.[1] Countries in the Arab-North African region and the Western Pacific ranked first and second with the highest prevalence of diabetes in the population aged 20–79 years among the seven regions in the world, 12.2% and 11.4%, respectively.[2] The Southeast Asian region, where Indonesia is located, ranks third, with a prevalence of 11.3%.[2] The IDF also projects the number of people with diabetes in the population aged 20–79 years in several countries that have identified the ten countries with the highest number of people with diabetes. China, India, and the United States rank in the top three, with 116.4 million, 77 million, and 31 million people with diabetes, respectively.[1] Indonesia is ranked seventh among the ten countries with the highest number of people with diabetes, at 10.7 million. Indonesia is the only country in Southeast Asia on the list, proving the magnitude of Indonesia's contribution to the prevalence of diabetes cases in Southeast Asia.[1]

The results of the 2018 Indonesian Basic Health Research/*Riset Kesehatan Dasar* (Riskesdas) showed that the prevalence of diabetes mellitus in Indonesia based on a doctor's diagnosis at the age of older than 15 years is 2%.[3] Those data showed an increase compared to the 1.5% prevalence of diabetes mellitus in the population of more than 15 years in the 2013 Indonesian Basic Health Research.[3,4] However, the prevalence of diabetes mellitus, according to the results of blood sugar tests, increased from 6.9% in 2013 to 8.5% in 2018.[3,4] This case showed that only 25% of people with diabetes know they have diabetes. The Special Capital Region of Jakarta had the highest prevalence of diabetes mellitus based on a doctor's diagnosis (3.4%).[5]

The 2018 Indonesian Basic Health Research data showed that 91% of patients receiving pharmacological therapy, such as anti-diabetic or insulin, were receptive to therapy. However, the 9% did not comply with therapy because they felt healthy, did not come to health facilities, and others.[3] Based on the Indonesian Endocrino-

***Correspondence***: Almira Fanny Rahmasari, Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, F Building 1st Floor, Kampus Baru UI Depok, Depok City, West Java, Indonesia 16424, E-mail: almirafanny18@gmail.com, Phone: +62 822-3663-9900*

Received : September 30, 2022
Accepted : December 05, 2022
Published : February 27, 2023

logy Association/*Perkumpulan Endokrinologi Indonesia* (Perkeni) consensus, diabetes management must be jointly carried out between the provision of pharmacological interventions and the application of healthy living behaviors, that is, nutritional therapy interventions and physical activity.[6] Anani, *et al.,* identified a relationship between taking medications, physical activity, exercise, and eating habits on the blood glucose levels of diabetes patients.[7] If people with diabetes with cardiovascular diseases did not comply with dietary recommendations, physical activity, and medications, they had a two-to-four times higher risk of dying from heart complications and stroke than those without diabetes.[8] In a study by Risnasari on 57 diabetic patients, 56.14% did not comply with the diet, 57.89% of patients had complications, and a relationship between the level of dietary adherence and the emergence of complications was identified.[9]

Diabetes self-management refers to the ability of a person to manage the conditions for living with diabetes physically and psychosocially toward behavioral change. Diabetes self-management is an important strategy for empowering patients to achieve controlled blood sugar.[10,11] Diabetes self-management is a complex behavior influenced by various factors, which in turn are influenced by personal factors (knowledge of diabetes, self-efficacy, perception of disease, personality, and other demographic factors), as well as environmental factors (doctor–patient communication, family support, and policy support). Identifying these determinants is very important in the development of effective intervention models to provide good health impacts for diabetes management.[6,10]

Anani, *et al.,* provided an overview of factors related to macro and micro complications of diabetes, including patient characteristics, demographics, lifestyle, hypertension, uncontrolled blood sugar, diabetes self-management, and duration of diabetes and insulin use patterns.[7] Problems that occur in people with diabetes can be controlled if the patient independently implements good and sustainable management. A previous study found good blood sugar control results in patients using self-monitoring techniques, including food intake, physical activity, and blood glucose levels.[12]

Fisher and Fisher provided a valuable and well-tested model for designing individual-level behavioral change interventions which target reflective regulatory processes. The model is the Information-Motivation-Behavioral skills (IMB), proposing that changes in the operation of reflective systems occur when an individual is well-informed, highly motivated, and has the necessary skills to perform the desired behavior.[13] As a result, intervention designers must assess which antecedents of information, motivation, or skills are lacking in the target population and address them in interventions designed to change their behavior patterns.[13]

A study by Hariawan showed respondents with a lower level of education had a prevalence of less than 2%.[14] This can be assumed to be related to lifestyle and access to case detection in health services groups at the academy/university education levels.[14] A study by Rahayu, *et al.*,[15] identified the relationship between occupation and diabetes mellitus. This statement is also supported by Grant's work, entitled Gender–Specific Epidemiology of Diabetes, in study by Nurhidayah, *et al.*, claiming that a person's work affects their level of physical activity; thus, their health by increasing the risk of diabetes mellitus.[16] Therefore, this study aimed to determine the relationship between IMB in diabetes self-management.

**Method**

The analysis of this study was based on the IMB skills model combined with the Health Belief Model and sociodemographic determinants of the successful control of type 2 diabetes mellitus (T2DM). This combination was used to create a diabetes self-management model, with IMB and sociodemographic determinants related to behavioral skills toward diabetes self-management. Information was developed using four pillars of diabetes management in Indonesia: dietary intake, physical activities, medication adherence, and blood sugar monitoring.[16] For information to be interpreted as knowledge, the patient must be diligent in maintaining dietary intake, physical activity, regularly taking medication, and monitoring blood sugar.

The motivation was developed using the Health Belief Model variables: perceived susceptibility, perceived severity, perceived benefit, perceived barrier, and self-efficacy. Motivation was interpreted as internal personal drives influencing one's willingness to change behavior. The sociodemographic was based on the influence factor of behavioral skills that affect diabetes self-management, such as age, sex, education level, occupation, and duration of having diabetes.

Behavioral skills were based on the theory of skills needed to change behavior: self-regulation, new motor skills, and social skills. Self-regulation means that individual behavior is goal-directed: setting goals, assessing how close (or far) one is to achieving goals, taking action to get closer to goals, and monitoring progress. New motor skills are intended to be learning and using new tools. For instance, the consumption of certain drugs requires medication reminder devices or Android-based applications; teaching patients how to use them is necessary. Social skills are defined as the ability to negotiate changes in behavior patterns with others and seek their support. People with diabetes must control their dietary intake even when attending a large event, such as a wedding. Social skills are necessary so that people with diabetes

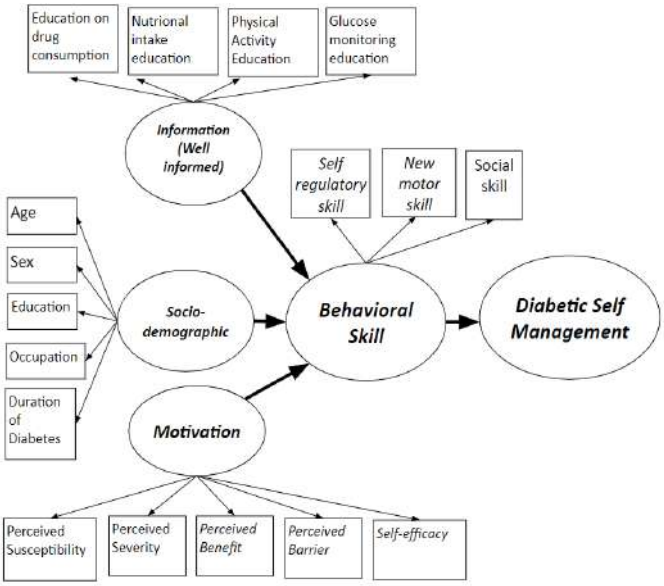
can maintain their behavior by communicating their condition to others.

Diabetes self-management is defined as the success of people with diabetes in maintaining dietary intake, physical activity, medication adherence, and blood sugar monitoring.[13] Variables and indicators directly or indirectly related to the independence of diabetes mellitus patients, namely, the variable IMB skills were analyzed to identify determinants that can influence the independent variable of diabetes patients.[13]

This study involved 277 participants of diabetes patients undergoing the Chronic Disease Management Program/*Program Pengelolaan Penyakit Kronis* (Prolanis) at five primary health cares (PHCs) of each administrative city of the Special Capital Region of Jakarta. The data were collected using questionnaires: 110 were spread directly, and 167 were distributed online via Google Forms. The data were collected from March to April 2022 when Prolanis activities were still active (with strict health protocols), even during the COVID-19 pandemic. The inclusion criteria set included diabetes patients registered as Prolanis participants, willing to sign the informed consent form, and could communicate well. While, the exclusion criteria were type 1 diabetes mellitus (T1DM) patients and others unwilling to participate. The number of samples taken in this study was adjusted to the amount recommended by Hair Jr., *et al.*,[17] in the structural equation modeling (SEM) analysis; while, the number of indicator variables added by the number of latent variables is multiplied by 5–10 so that it can be used as an estimated interpretation. The number of samples for SEM analysis can be seen as in Figure 1. The minimum number of samples in this study is: (17 + 5) x 10 = 220 respondents.[17] However, the study obtained 277 respondents for data analysis.

The questionnaire was designed based on the study framework. The sociodemographic section contains questions about age, sex, education level, occupation, and the length of time the patient had T2DM. For IMB skills, and diabetes self-management, respondents had to choose one of the following points: Strongly Agree (SA) if the statement was 76–100% following the respondent's condition/do/think; Agree (A) if the statement was 51–75% following the respondent's condition/do/think; Disagree (D) if the statement 26–50% was appropriate with respondent's condition/do/think; Totally Disagree (TD) if the statement 0–25% was appropriate (heavy disagreement) with respondent's condition/do/ think. Statements were made in both positive and negative statements, and each answer contained points ranging from 0 to 3—the more positive the respondent's answer, the more points they received.

The information contained statements regarding respondents' knowledge level and the education they had




**Notes:** Number of latent variables (oval shapes): information, motivation, sociodemographic, behavioral skills, diabetes self-management = 5.
Number of indicator variables (square shape): information on physical activity, information on nutritional intake, information on drug consumption, information on blood sugar monitoring, age, sex, occupation, education, duration of diabetes, barrier, benefit, self-efficacy, severity, susceptibility, new behavior motor skills, self-regulatory skills, and social skills = 17.

**Figure 1. Conceptual Framework**

received from the PHC where they were registered. Information was divided into four sections: dietary intake, physical activity, medication adherence, and blood sugar monitoring. Each indicator consisted of five statements. The information statement questionnaire was coded C1-20. Statements such as "controlling blood sugar levels is important so that people with diabetes do not experience complications" and "the way the officers convey the rules regarding nutritional intake are unclear" were put forth. The motivation was developed based on Health Belief Model variables: perceived susceptibility, perceived severity, perceived benefit, perceived barrier, and self-efficacy. Each had five statements, and the motivation statement questionnaire is coded D1-25. Statements such as "I do not think diabetes is a disease to worry about" and "Regular exercise helps maintain blood sugar at a normal level" were put forth.

Behavioral skills were divided into three parts: self-regulation, new motor, and social skills. Each part consisted of five statements, and the behavioral skills statement questionnaire was coded E1-15. Statements such as "I am not able to follow the rules of eating/drinking as taught by health workers" and "I am able to refrain from eating sugary foods/drinks excessively" were made. Diabetes self-management measured the compliance of people with diabetes in regulating nutritional intake, physical activity, medication adherence, and blood sugar monitoring. Statements such as "I always come to check myself at a health facility according to the schedule determined by the health officer" and "I like to forget or intentionally do not take my medication" were offered. Diabetes self-management had the questionnaire code B1-16.

Sociodemographic data were analyzed univariately using free version of SPSS 26.0 to obtain the frequency and percentage. Multicollinearity is a strong correlation or relationship between two or more independent variables in a multiple regression model. In analyzing the inner model, some assumptions need to be met, including the assumption of multicollinearity. If multicollinearity exists, then the predictive power is unreliable and invalid. A regression model can be said to have no multicollinearity if the variance inflation factor (VIF) value is less than nine. In the analysis model, multicollinearity was assumed to identify the influence of information, sociodemographic, and motivation on behavioral skills.

Validity and reliability tests determined the relationship between indicators and constructs. Validity was described based on factors related to the formed structural model, and average variance extracted (AVE) was used to measure the validity of the variables in the model. Variables with factors related to AVE>0.5 indicated that the variable has a relationship with other variables. The reliability test was carried out by looking at the composite reliability value. The results of composite reliability can be said to be satisfactory if the AVE is above 0.70. Model measurement was done to determine the relationship between indicators and the latent variable (inner model) and between latent variables (outer model) in a construct. The T-statistics were used to determine the significance level in the hypothesis testing, which made up a model by looking at the t-statistic>1.96. Decision-making was performed by examining the significance value (p-value). It is considered significant if the p-value is <0.05.

## Results

Table 1 shows the univariate sociodemographic analysis of the 277 respondents. The youngest respondent was 28 years old, and the oldest was 89 years old, with an age mean of 57.7 years. Based on the age category with a range of 10 years, the age category with the most number was 51–60 years, with 60 respondents (37.4%). Most respondents were females (65%), attaining senior high school (44.6%), and housewives (49.6%). The average duration of diabetes was 5.13 years, with the most common duration of suffering found at 1–5 years in 169 participants (60.8%).

Several presumptions must be met to analyze the inner model, including the presumption of multicollinearity. Multicollinearity renders the prediction power invalid and unreliable. If the VIF value is less than nine, a regression model is considered to have no multicollinearity. The multicollinearity assumption was created in the analysis model to determine how information, sociode-

**Table 1. Participants' Sociodemographic Characteristics**

| Variable | Category | n | % |
|---|---|---|---|
| Age | Mean = 57.67 years | | |
| | Minimum = 28 years | | |
| | Maximum = 89 years | | |
| | <30 years | 2 | 0.7 |
| | 31–40 years | 15 | 5.4 |
| | 41–50 years | 44 | 16 |
| | 51–60 years | 104 | 37.4 |
| | 61–70 years | 91 | 32.7 |
| | >70 years | 21 | 0.75 |
| Sex | Male | 98 | 35 |
| | Female | 178 | 65 |
| Education level | Elementary school | 48 | 17.2 |
| | Junior high school | 56 | 20.2 |
| | Senior high school | 124 | 44.6 |
| | Higher education | 49 | 17.6 |
| Occupation | Housewife | 138 | 49.6 |
| | Retired | 22 | 7.9 |
| | Civil servant | 10 | 7.1 |
| | Private employee | 44 | 15.8 |
| | Self-employed | 20 | 7.17 |
| | Unemployed | 33 | 11.87 |
| Duration of diabetes | <1 year | 1 | 0.3 |
| | 1–5 years | 169 | 60.8 |
| | 6–10 years | 84 | 30.2 |
| | 11–15 years | 14 | 5.04 |

mographic, and motivation on behavioral skills. All variables in Table 2 have a VIF value of less than nine. Information and behavioral skills have a VIF value of 2.547, and motivation and behavioral skills have a VIF value of 2.610. Sociodemographic and behavioral skill has the lowest VIF value of 1.067. In brief, this model did not have multicollinearity.

*Validity and Reability Test*

The value of AVE ranges from 0 to 1. The validity of the variables in the model was evaluated using AVE. If the AVE value is more than 0.5, a variable is valid. Because the AVE value is more than 0.5, the variables information, motivation, behavioral skills, and diabetes self-management are valid in Table 3. Therefore, the measuring model in this study had a valid discriminant validity.

The variables and indicators in this study were valid following the validity test; thus, the reliability test was carried out. The value of composite reliability was calculated for this test. If the composite reliability results are over 0.70, they are considered satisfactory. Table 4 was produced by weighing the importance of composite reliability and Cronbach's alpha to provide the results of this

**Table 2. Variable Multicollinearity Analysis**

| Variable | Behavioral Skill |
|---|---|
| VIF value between variable | |
| Information | 2.547 |
| Motivation | 2.610 |
| Sociodemographic | 1.067 |

**Note:** VIF = Variance Inflation Factor

**Table 3. Validity Test by Evaluating the Average Variance Extracted Score**

| Variable | AVE Validity | Test Criteria>0.5 |
|---|---|---|
| Behavioral skill | 0.868 | Valid |
| Diabetes self-management | 0.760 | Valid |
| Information (well-informed) | 0.682 | Valid |
| Motivation | 0.694 | Valid |

**Note:** AVE = Average Variance Extracted

**Table 4. Reliability Test by Evaluating the Average Variance Extracted Score**

| Variable | AVE Reliability | Test Criteria>0.7 |
|---|---|---|
| Behavioral skill | 0.952 | Reliable |
| Blood sugar monitoring | 0.928 | Reliable |
| Diabetes self-management | 0.962 | Reliable |
| Dietary intake | 0.931 | Reliable |
| Information (well-informed) | 0.895 | Reliable |
| Medication information | 0.855 | Reliable |
| Motivation | 0.919 | Reliable |
| New motor skill | 0.912 | Reliable |
| Perceived barrier | 0.972 | Reliable |
| Perceived benefit | 0.938 | Reliable |
| Perceived severity | 0.945 | Reliable |
| Perceived susceptibility | 0.948 | Reliable |
| Physical activity information | 0.743 | Reliable |
| Self-efficacy | 0.937 | Reliable |
| Self-regulation | 0.962 | Reliable |
| Social skill | 0.908 | Reliable |

**Note:** AVE = Average Variance Extracted

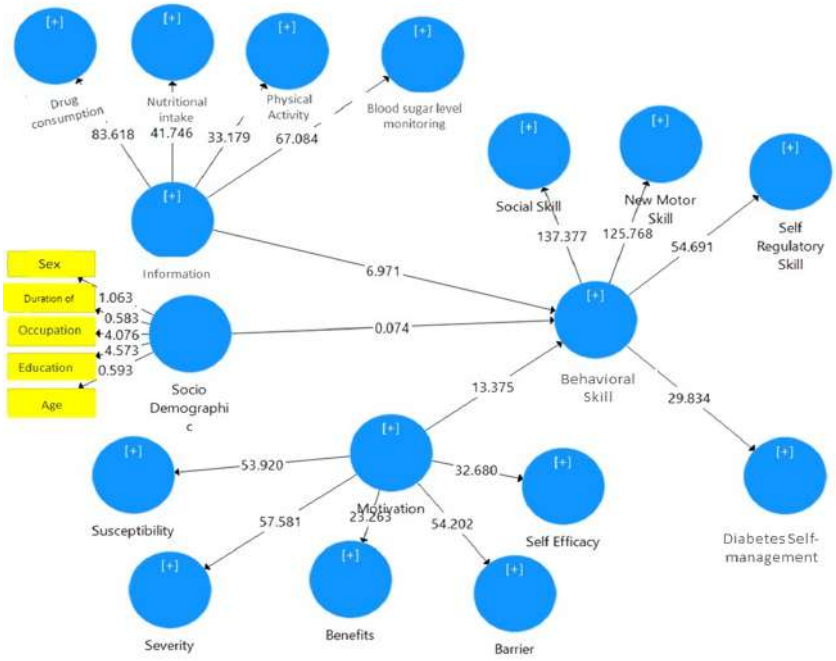



**Figure 2. Results of the T-Statistical Analysis**

**Table 5. T-Statistical Analysis of the Inner and Outer Model (among Latent Variables)**

| Model | Variable | Indicator | T-Statistics (\|O/STDEV\|) | p-value |
|---|---|---|---|---|
| Inner model | Behavioral skill | New motor skill | 125.768 | <0.001 |
| | | Self-regulatory skill | 54.691 | <0.001 |
| | | Social skill | 137.377 | <0.001 |
| | Information | Physical activity | 33.179 | <0.001 |
| | | Nutritional intake | 41.746 | <0.001 |
| | | Drug consumption | 83.618 | <0.001 |
| | | Blood sugar monitoring | 67.084 | <0.001 |
| | Motivation | Barrier | 54.202 | <0.001 |
| | | Benefits | 23.263 | <0.001 |
| | | Self-efficacy | 32.680 | <0.001 |
| | | Severity | 57.581 | <0.001 |
| | | Susceptibility | 53.920 | <0.001 |
| | Sociodemographic | Sex | 1.063 | 0.288 |
| | | Duration of diabetes | 0.583 | 0.560 |
| | | Occupation | 4.076 | <0.001 |
| | | Education | 4.573 | <0.001 |
| | | Age | 0.593 | 0.553 |
| Outer model | Behavioral skill | Diabetes self-management | 29.834 | <0.001 |
| | Information | Behavioral skill | 6.971 | <0.001 |
| | Motivation | Behavioral skill | 13.375 | <0.001 |
| | Sociodemographic | Behavioral skill | 0.074 | 0.941 |

study's outer model reliability test. If a variable's composite reliability value is greater than 0.7, it falls within the dependable category. According to Table 4, every variable has values greater than 0.7 and can be incorporated into the data-collecting model for analysis. Combined with the AVE table's findings, all variables were valid. Hence, all of the specified variables met the aspects of validity and reliability.

Based on Figure 2, the t-statistic results are presented in the Table 5 in which IMB skills variables have a significant influence on the constituent indicator. While, only occupation and education in sociodemographic variables had a significant effect on the constituent indicators. Behavioral skills positively affected diabetes self-management with an influence coefficient of 0.776, a t-statistics value of 29.834, and a p-value of <0.001. The information variable had a significant positive effect on behavioral skills with an influence coefficient of 0.316, a t-statistics value of 6.971, and a p-value of <0.001. Sociodemographic did not affect behavioral skills, with an influence coefficient of -0.002, a t-statistics value of 0.074, and a p-value of 0.941. Motivation had a positive effect on behavioral skills, with an influence coefficient of 0.643, a t-statistic value of 13.375, and a p-value of <0.001.

## Discussion

Based on the results of this study, the information variable had a significant positive effect on behavioral skills (t-statistic: 6.971, and p-value<0.001). These findings were in line with a previous study by Sulistyanawati (p-value<0.25), stating that providing information affected the behavior of disease management in diabetes patients.[18] Providing information becomes essential when motivated and skilled people lack an understanding of their behavior or its consequences. In addition, if people are unaware that their behavior patterns can lead to long-term illness, providing information allows them to change their behavior. This shows a relationship between information and the behavior of disease management in people with diabetes.[18]

This study also showed that the information variable significantly influenced its constituent indicators: physical activity, nutritional intake, drug consumption, and blood sugar monitoring. Physical exercise is a pillar in the management of T2DM, which is accompanied by nephropathy.[19] In addition to maintaining fitness, physical exercise can help the patient lose weight and improve insulin sensitivity, improving blood glucose control.[19] The results of a systematic review and meta-analysis of clinical study regarding the effect of structured physical exercise intervention for eight weeks on average blood glucose levels in 2–3 months (HbA1c) and body mass in T2DM patients showed a significant decrease in HbA1c.[19] Significantly after the physical exercise intervention compared to the control group (7.65 vs. 8.31%, taking into account a mean difference of 0.66%; p-value <0.001). In addition, a case-control study showed that regular exercise had a favorable effect on HbA1c levels, muscle strength, and markers of inflammation in the elderly with diabetes.[19]

In this study, the nutritional intake indicator significantly affected the information variable (t-statistics = 41.746 and p-value<0.001). These findings were in line

with a previous study by Talaei, *et al.*, which stated that dairy food intake was significantly associated with reduced T2DM risk.[20] Nutritional intake is an important part of managing T2DM, and the key to success is the full involvement of team members (doctors, nutritionists, other health workers, and patients and their families).[21] To achieve this target, nutritional intake should be given according to the needs of each person with diabetes.[21] The principle of eating arrangements for people with diabetes is almost the same as eating recommendations for the public: a balanced diet following each individual's caloric and nutritional needs.[21] People with diabetes need to emphasize the importance of regular meal schedules and the type and amount of calorie content, especially in those taking medicines that increase insulin secretion or insulin therapy.[21]

The results of this study showed that motivation positively influenced behavioral skills, with an influence coefficient of 0.643, a t-statistic value of 13,375, and a p-value of <0.001. This finding was in line with a study by Ernawati, *et al.*, finding that motivation has a significant influence on the behavior of diabetic patients.[22] Furthermore, this study also revealed that behavioral skills had a positive effect on diabetic self-management with an influence coefficient of 0.776, a t-statistic value of 29.834, and a p-value of <0.001. These results aligned with a study by Nusantara, finding that behavioral skills improve self-care in diabetes patients.[23] There are three components in behavioral skills: self-regulatory skills (useful ways of thinking about self-regulation), new motor skills (learning and using new tools), and social skills (one's ability to negotiate changes in behavior patterns with others and seek support).[23]

In the occupation variable, the group of unemployed respondents had a higher prevalence of diabetes than other groups. A similar study found significant results between work status and DM.[11] The same result was also shown in study by Pahlawati, *et al.,* stating that people with a lower level of education had an increased risk of developing DM compared to people with higher education almost five times compared to people without DM with an OR value of 4.9 (95% CI = 1.82–13.12).[24] The same result was also obtained in Kusuma's study, stating that the characteristics of respondents were not related to self-efficacy except for occupation and education. Family support is known related to the self-efficacy of diabetes patients.[25]

Education level does not directly affect the incidence of diabetes mellitus; however, it supposedly affects diet by selecting the type of food consumed daily. Yuanita, *et al.,* stated that education or health education played an important role in the DM management.[26] Education for T2DM patients is important as an initial action to control DM. Diabetes mellitus self-management education (DSME) is a common and effective type of education for improving clinical outcomes and the patients's quality of life. In the DSME process, healthcare workers treating DM patients with self-care strategies control metabolism, prevent complications, and improve the quality of life of DM patients.[26] A study by Hariawan also stated that diet and physical activity had a relationship with the DM incidence (p-values of 0.02 and 0.009, respectively).[14] These results confirm that an unhealthy diet is part of a lifestyle predisposing factor for DM. A poor diet can lead to obesity, which predisposes a person to diabetes as a more significant amount of insulin is needed to regulate metabolism in obese people compared to normal people.[14] This is in line with a study in Surabaya City, that nutrition affects attitudes to functional food for the diabetics.[27]

## Conclusion

This study reveals that the behavior skill variable positively affects diabetes self-management. In addition, the information and motivation variable have a significant positive effect on behavior skills; while, the sociodemographic variable does not affect behavior skill. In brief, behavioral skills significantly and positively has an impact on diabetes self-management. This study is recommended for further study related to diabetic self-reliance to control diabetes, which should quickly produce intervention models and instruments for self-reliance for diabetes patients as an effort to increase individual independence in intensive diabetes control.

**Abbreviations**

IDF: International Diabetes Federation; Riskesdas: *Riset Kesehatan Dasar*; Perkeni: *Perkumpulan Endokrinologi Indonesia*; IMB: Information-Motivation-Behavioral Skills; T2DM: Type 2 Diabetes Mellitus; Prolanis: *Program Pengelolaan Penyakit Kronis*; PHC: Primary Health Care; SEM: Structural Equation Modelling; VIF: Variance Inflation Factor; AVE: Average Variance Extracted; DSME: Diabetes Self-Management Education.

**Ethics Approval and Consent to Participate**

Ethical approval was granted by the Research and Community Engagement Ethical Committee, Faculty of Public Health, Universitas Indonesia. No.: Ket-36/UN2.F10.D11/PPM.00.02/2022.

**Competing Interest**

The author declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

**Availability of Data and Materials**

The generated dataset is available to share from the corresponding author upon a reasonable request.

**Authors' Contribution**

DK conceptualized and designed the study, collected data, and performed the analysis and interpretation of the analysis results. AB and CC provided guidance on data analysis, review, and approval of manuscripts. AP and AFR provided the latest study literature and prepared draft manuscripts. AP and AFR also served as correspondence authors.

**Acknowledgment**

Authors are very thankful to Prof. DR. Dr. Fachmi Idris, M.Kes, Prof. dr. Amal Chalik Sjaaf, SKM, Dr.PH, and DR. Drs. Tris Eryando, MA from Faculty of Public Health of Universitas Indonesia; DR. Ummi Azizah Rachmawati, M. Kom, S.Kom from Universitas Yarsi; DR. Dr. Andi Alfian Zainuddin, MKM from PB IDI, DR; I Ketut Agung Enriko, ST, MSc from PT Telkom Indonesia Tbk; and DR. Dr. Trihono, MSc from Ministry of Health Republic Indonesia for valuable support and reviewing this article.

## References

1. International Diabetes Federation. IDF Diabetes Atlas Ninth Edition 2019. Brussels: International Diabetes Federation; 2019.
2. Afroz A, Zhang W, Loh AJW, Lee DXJ, Billah B. Macro- and microvascular complications and their determinants among people with type 2 diabetes in Bangladesh. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2019; 13 (5): 2939-46.
3. Badan Penelitian dan Pengembangan Kesehatan. Hasil utama Riskesdas 2018. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018.
4. Badan Penelitian dan Pengembangan Kesehatan. Hasil utama Riskesdas 2013. Jakarta: Kementerian Kesehatan Republik Indonesia; 2013.
5. Direktorat Pencegahan dan Pengendalian Penyakit Tidak Menular. Infodatin: tetap produktif, cegah, dan atasi diabetes mellitus. In: Widiantini W. Jakarta: Kementerian Kesehatan Republik Indonesia; 2020.
6. Perkumpulan Endokrinologi Indonesia. PEDOMAN PENGELOLAAN DAN PENCEGAHAN DIABETES MELITUS TIPE 2 DI INDONESIA 2021. Jakarta: PB PERKENI; 2021.
7. Anani S, Udiyono A, Ginanjar P. Hubungan antara perilaku pengendalian diabetes dan kadar glukosa darah pasien rawat jalan diabetes melitus (studi kasus di RSUD Arjawinangun Kabupaten Cirebon). Jurnal Kesehatan Masyarakat. 2012; 1 (2): 466-78.
8. Lattal KA, Perone M. Handbook of research methods in human operant behavior. New York: Springer Science & Business Media; 1998.
9. Risnasari N. Hubungan tingkat kepatuhan diet pasien diabetes mellitus dengan munculnya komplikasi di Puskesmas Pesantren II Kota Kediri. Efektor. 2014; 25 (1): 15-9.
10. American Diabetes Association. Standards of medical care in Diabetes—2013. Diabetes Care. 2012; 36 (Supplement_1): S11–66.
11. Mahmud FR, Sudirman S, Afni N. Faktor-faktor yang berhubungan dengan penyakit diabetes mellitus di ruang Poli Interna RSUD Mokopido Kabupaten Tolitoli. Jurnal Kolaboratif Sains. 2018; 1 (1): 168-75.
12. Farida I. Determinan perilaku manajemen perawatan diri pada pasien diabetes melitus tipe 2 di Kota Tangerang Selatan. Jurnal Ilmu Kesehatan Masyarakat. 2018; 7 (4): 207-17.
13. Chang SJ, Choi S, Kim SA, Song M. Intervention strategies based on information-motivation-behavioral skills model for health behavior change: a systematic review. Asian Nursing Research. 2014; 8 (3): 172–81.
14. Hariawan H, Fathoni A, Purnamawati D. Hubungan gaya hidup (pola makan dan aktivitas fisik) dengan kejadian diabetes mellitus di Rumah Sakit Umum Provinsi NTB. Jurnal Keperawatan Terpadu. 2019; 1 (1): 1-7.
15. Komariah K, Rahayu S. Hubungan usia, jenis kelamin dan indeks massa tubuh dengan kadar gula darah puasa pada pasien diabetes mellitus tipe 2 di Klinik Pratama Rawat Jalan Proklamasi, Depok, Jawa Barat. Jurnal Kesehatan Kusuma Husada. 2020; 11 (1): 41-50.
16. Nurhidayah, Agustina V, Rayanti RE. Penerapan perilaku pencegahan penyakit diabetes mellitus menggunakan Health Belief Model di Puskesmas Sidorejo Lor – Salatiga. Jurnal Keperawatan Muhammadiyah. 2020; 5 (2): 61-9.
17. Hair Jr JF, Hult GTM, Ringle CM, Sarstedt M, Danks NP, Ray S. Partial least squares structural equation modeling (PLS-SEM) using R: a workbook. Cham: Springer; 2021.
18. Sulistyanawati N, Padmawati RS. Pengelolaan penyakit pada pasien diabetes melitus: akses layanan informasi pola konsumsi dan komplikasi gigi-mulut. Berita Kedokteran Masyarakat. 2017; 33 (8): 411-16.
19. Utomo MRS, Wungouw H, Marunduh S. Kadar HbA1C pada pasien diabetes mellitus tipe 2 di Puskesmas Bahu Kecamatan Malalayang Kota Manado. e-Biomedik. 2015; 3 (1).
20. Talaei M, Pan A, Yuan JM, Koh WP. Dairy intake and risk of type 2 diabetes. Clin Nutr. 2018; 37 (2): 712–8.
21. Fitriyah L, Sunarti S. Physical activity improves muscle strength and reduces inflammatory markers in diabetic elderly patients. Jurnal Kedokteran Brawijaya. 2014; 28 (2): 155-8.
22. Ernawati E, Setiawati EP, Kurniawan T. Pengaruh motivasi internal dan eksternal terhadap diabetes self management di wilayah Kecamatan Gombong Kabupaten Kebumen. Jurnal Sistem Kesehatan. 2015; 1 (2): 55-62.
23. Nusantara AF. IMB (information, motivation, behavioral skill) pada self care pasien DM Tipe 1 di Kabupaten Probolinggo [Thesis]. Surakarta: Universitas Muhammadiyah Yogyakarta; 2016.
24. Pahlawati A, Nugroho PS. Hubungan tingkat pendidikan dan usia dengan kejadian diabetes melitus di wilayah kerja Puskesmas Palaran Kota Samarinda Tahun 2019. Borneo Student Research. 2019; 1 (1): 1-5.
25. Kusuma H, Hidayati W. Hubungan antara motivasi dengan efikasi diri pada pasien diabetes mellitus tipe 2 di Persadia Salatiga. Jurnal Keperawatan Medikal Bedah. 2013; 1 (2): 132-41.
26. Yuanita A, Wantiyah W, Susanto T. Pengaruh diabetes self management education (DSME) terhadap resiko terjadinya ulkus diabetik pada pasien rawat jalan dengan diabetes mellitus (DM) tipe 2 di RSD dr. Soebandi Jember (The Influence of Diabetes Self Management Education (DSME) to The Risk. Pustaka Kesehatan. 2014; 2 (1): 119-24.
27. Susanti CE, Tedjasuksmana B. Effect of knowledge on nutrition diet behavior with attitude to mediation functional foods for diabetes mellitus patients in Surabaya. Conference in Business, Accounting, and Management. 2012; 1 (1): 151-64.