

The Relationship between Health Literacy, Diabetes Distress, and Dietary Adherence in Diabetes Mellitus Patients

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ABSTRACT

OBJECTIVE: To explain the relationship between health literacy and diabetes distress with dietary adherence.

METHODOLOGY: This study used a cross-sectional study that included 104 DM patients in the working area of public health centre in Sidoarjo, Indonesia, from February until April 2023. The criteria for inclusion in the study included: 1) type 1 and type 2 diabetes mellitus patients; 2) 18 to 65 years of age (productive age); 3) long-suffering >6 months; 4) reading and writing ability. The instruments used were demographic characteristics, the Diabetes Health Literacy Scale (DHLS) questionnaire, the Distress Diabetes Scale questionnaire (DSS), and the Self-Management Dietary Compliance Questionnaire (SMDBQ).

RESULTS: The results showed that the majority of respondents were female 70 (67.3%), aged 56-65 years 62 (59.6%), and respondents suffered from DM for <5 years 45 (43.3%). There is a relationship between the level of health literacy and dietary adherence ($p < 0.001$, $r = 0.489$), as well as between diabetes distress and dietary adherence ($p < 0.001$, $r = -0.355$).

CONCLUSION: The higher the health literacy, the better the diabetes management, and the lower the diabetes distress, the better the dietary compliance.

KEYWORDS: Diabetes; Dietary Adherence; Health Literacy; Diabetic Distress; Health Risk; Diabetes Management

INTRODUCTION

Diabetes mellitus (DM) has become a public health issue at global, national, and local levels¹. The high incidence of diabetes mellitus in Indonesia often leads to various management challenges². Dietary planning is a primary treatment for diabetes mellitus, and patient adherence to nutritional principles is a common challenge³. Effective self-management requires understanding how health behaviors impact diabetes, and good health literacy enables patients to comply with these behaviors⁴. Additionally, regular dietary adherence can significantly stress patients, leading many to struggle with compliance⁵.

According to the International Diabetes Federation (IDF), 463 million people worldwide had diabetes mellitus in 2019. In 2021, Indonesia ranked fifth among ten countries with 19.5 million sufferers⁶. East Java reported 867,257 cases of diabetes mellitus in

2021, and Sidoarjo had 75,909 cases. Dietary therapy success for diabetes mellitus is measured by dietary adherence, which can be challenging. Studies in the USA show a 40-50% adherence rate among type 2 diabetes patients⁷, while in New Zealand, only 22% of type 2 diabetes patients fully adhered to dietary recommendations⁸.

Dietary therapy principles for diabetes involve monitoring calorie intake, meal timing, and food types. Education, knowledge, employment, income, family support, healthcare support, awareness of healthy living, and self-motivation can affect adherence to these principles. Psychological stress significantly influences eating behaviors⁹, and low health literacy also impacts dietary adherence¹⁰.

Successful chronic disease management relies on an individual's ability to access, understand, and use health information and services, known as health literacy¹¹. Poor health literacy often results from inadequate information access, which can be influenced by low education, limited access to information, poor communication, lack of motivation, and differing perceptions¹². Low health literacy is significantly related to high-stress perception levels¹³. Psychological stress can arise from receiving a diabetes diagnosis and the perceived challenges it brings. The stress experienced depends on the difficulties patients face, such as food restrictions and dietary habits before illness¹⁴. Improving behavior can help manage the condition, leading to a better quality of life and longevity¹⁵.

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Addressing dietary adherence issues aligns with the Precede-Proceed model, which examines human behavior and influencing factors and aims to positively change, maintain, and improve behavior. Information access (enabling factor) and psychological stress (predisposing factor) influence health behaviors (dietary adherence)¹⁶. To motivate diabetes patients to adhere to their diet, health promotion through education is recommended¹¹. Adequate information access can enhance health literacy, and continuous management of diabetic distress may improve dietary adherence and reduce the risk of acute and chronic complications in diabetes mellitus patients.

METHODOLOGY

Study Design

The cross-sectional study included people with diabetes mellitus type 1 and type 2 in the working area of the public health centre in Sidoarjo, Indonesia. Cross-sectional studies are observational studies that analyze data from a population simultaneously. They are often used to measure the prevalence of health outcomes, understand health determinants, and describe a population's features. Cross-sectional studies do not follow individuals over time. They are usually inexpensive and easy to conduct.

Population, Samples and Sampling

The population in this study is DM with type 1 or 2 in the public health centre in Sidoarjo, Indonesia. The sample size in this study is a total of 104 respondents that have been determined according to the inclusion and exclusion criteria. The sample size in this research was determined using the Solvin formula. The criteria for inclusion in the study included: 1) type 1 and type 2 diabetes mellitus patients; 2) 18 to 65 years of age (productive age); 3) long-suffering > 6 months; 4) reading and writing ability. Exclusion criteria in this study include: 1) non-co-operative diabetes mellitus patients; 2) diabetes mellitus people with severe physical disorders or conditions that do not enable them to participate in the study, such as body paralysis, infectious diseases, and special needs.

This study uses non-probability sampling. The data collection process was carried out from February - April 2023 in the public health centre in Sidoarjo, Indonesia.

Instruments

In this study, the independent variables are health literacy and diabetes distress. The dependent variable is the dietary adherence of diabetes mellitus patients. Demographic data (age, sex, educational level, monthly income, family history, comorbidity) were collected using an open-ended questionnaire developed by the author. The Self-Management Dietary Behaviors Questionnaire (SMDBQ)¹⁷, the Diabetes Distress Scale (DDS) questionnaire¹⁸, and the Diabetes Health Literacy Scale (DHLS) questionnaire, which have been adapted into Indonesian, were instruments used¹⁹.

SMDBQ Questionnaire validity was tested with 15 respondents, showing item correlation values from 0.544 to 0.982. The reliability test resulted in a Cronbach's alpha of 0.968. DHLS Questionnaire validity and reliability were tested at the Public Health Center in Sidoarjo with 15 respondents similar to the study participants. Item correlation values ranged from 0.490 to 0.886, and Cronbach's alpha was 0.947. The validity of the Diabetes Distress Questionnaire was tested with 324 participants across four hospitals and two primary care facilities on Java Island. Item correlation values ranged from 0.41 to 0.98. Reliability tests showed Cronbach's alpha values of 0.81 (Emotional Burden), 0.83 (Distress Related to Healthcare Providers), 0.78 (Distress Related to Care Difficulties), and 0.83 (Interpersonal Distress).

Procedure

The research was conducted offline at a public health centre in Sidoarjo, Indonesia. Initial respondent outreach occurred in Elderly Poly in April 2023. Researchers also conducted door-to-door diabetic patient visits based on health workers' data. The study involved 104 respondents selected through purposive sampling. Researchers explained the study's purpose, benefits, and procedures to participants, obtained informed consent, and then had them complete a questionnaire in 15-25 minutes. The collected data were analyzed to conclude.

Data Analysis

The study employed descriptive and inferential analysis, explicitly using Spearman's Rho test to assess the strength of relationships between variables. This test, suitable for continuous or ordinal variables with a monotonic relationship, was conducted using SPSS software version 25.0. The data tested were on an ordinal scale.

RESULTS

The public health centre in Sidoarjo, Indonesia, has the following services: general poly, elderly poly, dental poly, MCH-MTBS-KB poly, nutrition poly, supporting services, sanitation clinic services, 24-hour emergency services, 24-hour maternity services, community program health services, inpatient services, referral ambulances, and clinical laboratory examination services.

Table I presents demographic data from 104 respondents: 67.3% are female, with most being elderly (51-60 years old, 47.1%). The highest education level is high school graduation (41.3%). Most respondents are married (92.3%) and have an income below the Sidoarjo minimum wage (85.6%), with many working as homemakers (39.4%). The majority have had diabetes for less than 5 years (43.3%) and visit healthcare services 7-12 times annually (86.5%) for medication and routine blood sugar checks.

Table II indicates that 93.3% of diabetes patients at the public health centre in Sidoarjo, Indonesia, have good health literacy. **Table II** reveals that 55.8% of

these patients experience moderate diabetes distress. According to **Table II**, 71.2% of respondents exhibit moderate dietary compliance.

Table III presents two key findings from Spearman's Rho test for health literacy and dietary compliance. The test shows a p-value of <0.001, indicating a significant relationship. The coefficient of 0.489 suggests a positive correlation, meaning that higher health literacy is linked to better dietary compliance among diabetes patients. For diabetes distress and dietary compliance, the test results had a p-value of <0.001, also indicating a significant relationship. The correlation coefficient of -0.355 reflects a negative correlation, meaning that lower diabetes distress is associated with higher dietary compliance.

Table I: Distribution of Demographic Characteristics

Demographic Characteristics	Category	n	%
Gender	Male	34	32.7
	Female	70	67.3
Age	26 - 35 (Early Adulthood)	3	3.9
	36 - 45 (Late Adulthood)	4	3.8
	46 - 55 (Early Elderly Period)	35	33.7
	56 - 65 (Late Elderly)	62	59.6
Status	Get Married	96	92.3
	Not yet married	1	1.0
	Widow/Widower	7	6.7
Education	6 years of education	14	13.5
	9 years of education	26	25.0
	12 years of education	43	41.3
	College/University	21	20.2
Job	Teacher	5	4.8
	Housewife	41	39.4
	Employee	3	2.9
	Farmers	2	1.9
	Government Employees	9	8.7
	Not Working	15	14.4
Monthly income	Self-employed	29	27.9
	Less than the minimum regional wage (<Rp4.518.581)	89	85.6
Duration of Diabetes	Equal to or more than the minimum regional wage (≥Rp4.518.581)	15	14.4
	<5 years	45	43.3
	5 – 10 years	43	41.3
Frequency of visits to health services	>10 years	16	15.4
	4 - 6 x in 12 Months	12	11.5
	7 - 12x in 12 Months	90	86.5
	>12x in 12 Months	2	1.9

Table II: Distribution of Health Literacy Level of Diabetes Mellitus Patients, Diabetes Distress Level of Diabetes Mellitus Patients, and Dietary Adherence Level of Diabetes Mellitus Patients

Health Literacy	n	Percentage (%)
Less	7	6.7
Good	97	93.3
Total	104	100.0
Distress Diabetes	n	Percentage (%)
Low	38	36.5
Medium	58	55.8
High	8	7.7
Total	104	100.0
Dietary Adherence	n	Percentage (%)
Low	17	16.3
Medium	74	71.2
High	13	12.5
Total	104	100.0

Table III: Distribution of the Relationship between Health Literacy and Dietary Adherence and the Relationship between Health Literacy and Dietary Adherence

Health Literacy	Dietary Adherence							
	Low		Medium		High		Total	
Less	7	6.7	0	0	0	0	7	6.7
Good	10	9.6	74	71.2	13	12.5	97	93.3
Total	17	16.3	74	71.2	13	12.5	104	100.0
The results of the Spearman's Rho test (p<0.001) (r=0.489)								
Distress Diabetes	Dietary Adherence							
	Low		Medium		High		Total	
	n	%	n	%	n	%	n	%
Low	4	3.8	23	22.1	11	10.6	38	36.5
Medium	9	8.7	47	45.2	2	1.9	58	55.8
High	4	3.8	4	3.8	0	0	8	7.7
Total	17	16.3	74	71.2	13	12.5	104	100.0
The results of the Spearman's Rho test (p<0.001) (r=-0.355)								

DISCUSSION

Research on people with diabetes shows good health literacy, but the numeracy dimension is the weakest, particularly in understanding diabetes-related information presented in charts, graphs, or comparisons; this is consistent with previous studies linking poor numeracy skills to poor self-care²⁰. In diabetes, low numeracy is associated with less knowledge, lower self-efficacy, reduced self-care

participation, and inadequate glycemic control. The study suggests that age, particularly among older adults with weaker numerical skills, contributes to low numeracy in diabetes patients²¹.

The questionnaire results indicated high scores in informational health literacy, particularly in understanding diabetes-related educational materials; this shows that exposure to such information improves health literacy. Most participants relied on healthcare professionals as their primary information source, echoing Debre Markos, Ethiopia findings²². Education level and knowledge significantly impact health literacy, with individuals having over 12 years of education showing better literacy. Gender also plays a role, as women are generally better at navigating healthcare systems²³. Regular visits to health services improve understanding of diabetes self-management, leading to increased awareness and sensitivity to the disease's consequences.

The study found that individuals with diabetes generally experience moderate distress, with the highest emotional burden related to fear and pressure about the condition. This is consistent with research on the challenges of accepting diabetes and adapting to dietary restrictions²⁴. Most respondents, particularly housewives, faced higher emotional distress due to their constant reflection on managing the disease²⁵, due to their constant reflection on managing the disease.

The study found that the lowest distress scores were related to interactions with health workers, as frequent consultations helped patients feel more confident in voicing concerns; this supports previous research that shows that good communication with healthcare providers reduces distress²⁶. Most respondents (43.3%) had diabetes for less than five years, and moderate distress was linked to the duration of the condition, as an adaptation to diabetes can affect distress levels. Research suggests that longer illness duration is associated with lower distress levels²⁷.

In this study, it was also found that dietary compliance levels are moderate. The highest scores on the questionnaire were for schedule setting, with most respondents regularly having breakfast in the morning; this indicates that respondents can follow a predetermined diet four days a week²⁸. Experimental evidence indicates that skipping breakfast and eating large meals later increases insulin resistance, LDL levels, and total cholesterol, leading to hyperglycemia²⁹.

The study found the lowest scores in behavior regulation, particularly in preventing hypoglycemia, which aligns with Ethiopian research showing only 21.4% practicing good prevention; this emphasizes the need for better education on hypoglycemia prevention, as health workers at the Primary Health Centre rarely provided information on the topic³⁰. Dietary compliance was moderate due to adequate diabetes knowledge but a lack of family support, which was consistent³¹. The study also suggests that age,

especially for those aged 56-65, may influence dietary compliance, as older individuals tend to manage better and act on health information.

The study found a significant relationship between health literacy and dietary adherence among diabetes patients at the public health centre. Health literacy is crucial for accessing care, managing chronic conditions, and maintaining overall health. It empowers individuals to take an active role in decision-making and self-care²². In the other research found a significant direct relationship between health literacy and adherence to diet, exercise, and blood sugar monitoring. Individuals with high health literacy tend to follow their diet and medication regimens. In contrast, those with low health literacy often struggle to understand the importance of diet for blood sugar control and exhibit poor dietary adherence³².

Demographic data show that respondents' monthly visits to the health centre likely improve their health literacy and self-management behaviors. This supports previous research linking frequent visits to higher communicative health literacy, which enhances the ability to gather and exchange information effectively with physicians³³. A strong doctor-patient relationship fosters better communication and proactive involvement in treatment decisions³⁴. The effectiveness of health literacy depends on the complexity of the information provided, making it essential for thriving health development efforts in Indonesia³⁵.

The study found that high health literacy is associated with moderate dietary adherence and better diabetes self-management³². Better health literacy improves self-care skills and positively affects HbA1c levels, whereas limited health literacy leads to poorer diabetes management. Maintaining motivation and consistency in self-care is crucial, requiring skills for daily decision-making, such as responding appropriately to blood sugar readings³¹. Healthcare settings can enhance self-care management by improving health literacy through educational methods, both in-person and written²². The research highlights the importance of addressing health literacy in managing diabetes.

The research indicates a significant relationship between diabetes distress and dietary compliance among people living with diabetes at a public health centre in Sidoarjo, Indonesia. The highest level of distress was found in the emotional burden, which leads to reduced motivation for regular self-management and adherence to a diabetes diet³⁰. High distress negatively impacts diabetes management and quality of life, consistent with other studies showing a significant link between diabetes self-management and stress levels related to diet².

The study results show that better diabetes self-management is associated with lower levels of distress among individuals on a diabetes diet. Stress is a confounding variable, negatively affecting diabetes management, metabolic control, and

psychological well-being¹. Researchers assume that dietary compliance is influenced by diabetes distress. People with DM have not been able to accept their condition with DM and are not used to a lifestyle of abstaining from eating, and have not been able to handle factors that cause stress well²⁴.

Questionnaire responses reveal that diabetes patients predominantly experience fear, worry, and depression about living with the disease. However, they generally do not seem very concerned about lapses in their diet, with some patients even preferring to take a break from dietary restrictions. Emotional distress tends to increase with noticeable changes in physical health or disruptions in glycemic control³¹. To reduce distress, improving patients' knowledge, boosting self-efficacy for physical activity, promoting healthier diet choices, enhancing stress coping skills, and receiving motivation from health workers are recommended strategies²⁴.

Respondents regularly visit health services with family members, where healthcare workers help manage diabetes-related distress²⁸. Families influence dietary choices, which affect stress levels and self-management³⁰. Many respondents, particularly housewives with low incomes, face financial barriers to self-management, and healthcare workers can assist by providing information to address challenges like affording medication and healthy food²⁴.

The study acknowledges several limitations, including using a cross-sectional design due to logistical challenges and limited data collection personnel. This design may not fully capture causal relationships, suggesting that future research could benefit from a cohort design to understand these dynamics better. Additionally, participants' health behaviors may have changed over time, and the study did not extensively include other routine parameters for diabetes management, which could offer a more objective assessment.

CONCLUSION

The research indicates that higher health literacy and lower diabetes distress are associated with better dietary adherence among people with diabetes mellitus. Future research should explore lifestyle management programs such as diabetes support groups, seminars, and distress assessments during healthcare visits to improve diet compliance and health literacy. These initiatives could also help reduce diabetes-related stress, particularly in older adults, and adapt to evolving technological advancements.

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AUTHOR CONTRIBUTION

Pratiwi IN: Major contribution to conceptual framework
Lailiyaturrohmah ZDN: data collection, data analysis and writing the manuscript

Suarilah I: Major contribution in conceptualizing the method

Bakar A: Significant contribution to the supervision of the study

Widyawati IY: major contribution to the interpretation of results and supervision of the study

Nursalam N: significant contribution to the supervision of the study

Yahaya NA: Major contribution to the supervision of the study

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