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FAKULTAS KESEHATAN MASYARAKAT UIVERSITAS TADULAKO
http://jurnal.fkm.untad.ac.id/index.php/preventif
ISSN (P) 2088-3536 ISSN (E) 2528-3375

The Influence of the Physical Environment on the Quality of Life of Type 2 DM Patients in the Belawan Community Health Center Area

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ABSTRACT

Diabetes is a major health problem. According to the International Diabetes Federation (IDF), Indonesia is the fifth country with the highest number of diabetes sufferers, with 19.5 million people in 2021, projected to increase to 28.6 million by 2045 (IDF, 2024). In this study, researchers aimed to examine the influence of the physical environment on the quality of life of Type 2 DM sufferers in the Belawan Community Health Center area. This study used an observational analytical method with a cross-sectional design. The data used were primary and secondary data, with a population of 226 people. The sampling technique used was the Slovin formula, resulting in a sample size of 70 respondents. In this study, researchers found that Bedroom and Family Room Ventilation (p = 0.000; 0.005), Bedroom Humidity (p = 0.015), Bedroom and Family Room Ceiling Height (p = 0.001; 0.028), Bedroom and Family Room Lighting (p = 0.000; 0.001) had a significant relationship to the influence of the physical environment on the quality of life of Type 2 DM sufferers in the Belawan Community Health Center area. While Family Room Humidity (p = 0.085) did not have a significant relationship to the influence of the physical environment on the quality of life of Type 2 DM sufferers in the Belawan Community Health Center area. The most influential factors in this study were Bedroom Ventilation and Bedroom Lighting (p - 0.000; 0.001 OR = 9.582; 3.727).
Keywords: *Quality of life; Type 2 DM; Physical environment*

Published by:
Tadulako University
Address:
Jl.Soekarno Hatta KM 9. Kota Palu, Sulawesi Tengah, Indonesia.
Phone: +6282197505707
Email: preventifjournal.fkm@gmail.com

Article history :
Received : 26 06 2025
Received in revised form : 15 08 2025
Accepted : 20 08 2025
Available online : 31 08 2025

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INTRODUCTION

Diabetes mellitus (DM) is currently a global health threat. Various epidemiological studies show an increasing trend in the incidence and prevalence of type 2 DM in various regions of the world [1] . Based on data from the International Diabetes Federation (IDF), the number of adults (20-79 years) with diabetes worldwide is estimated to reach 537 million in 2021. This number is expected to continue to grow to 643 million in 2030 and 783 million in 2045, where out of every 4 adults, 3 have diabetes living in low- and middle-income countries [2] .

According to the International Diabetes Federation (IDF), Indonesia is the fifth country with the highest number of diabetes sufferers, namely 19.5 million people in 2021 and is projected to increase to 28.6 million people in 2045 [2]. Based on population growth patterns, it is estimated that in 2030 there will be 194 million people aged 20 years and above, assuming that DM occurs more in urban areas (14.7%) and rural areas (7.2%), it is estimated that there are 28 million diabetes sufferers in urban areas and 13.9 million people in rural areas [3] .

The proportion of diabetes mellitus sufferers in 2019 in North Sumatra was 249,519 people and the number of patients who utilized medical services was 144,521 people or 57.92% of the remaining 104,998 people could not be examined by health services because they did not check themselves at health services [4] . Based on data analysis by the Central Statistics Agency (BPS) and processed by Talenta Data Indonesia (TDI), the population of Medan City in 2023 is estimated to be 2,494,512 people [5] . According to Basic Health Research data, North Sumatra province reported the prevalence of diabetes mellitus based on doctor's diagnosis in residents of all age groups in North Sumatra province of 1.39%, in Medan city of 2.04% [6] .

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The prevalence of diabetes based on doctor's diagnosis in the population aged 15 years and above in North Sumatra is 2.03% and in Medan City is 2.31% [6] . The physical environment has a very large influence on a person's health. Places we frequently visit such as home, office, and school can affect a person's physical and mental well-being. In addition, exposure to hazardous environmental conditions can also have a serious impact on a person's health [7] . The problem of quality of life for people with diabetes mellitus (DM) is quite complicated and complex because it affects various important aspects of a person's life [8] . Diabetes mellitus has a negative impact on quality of life. This poor quality of life is also related to a person's physical health condition [9] .

Based on an initial survey conducted by researchers at the Belawan Community Health Center, it was found that there were 226 people affected by type 2 diabetes in the community. According to data from the Belawan Community Health Center, the highest prevalence of type 2 diabetes was in Belawan I Village with 96 people, while in Belawan II Village there were 85 people and Bagan Deli Village there were 45 people. Based on the problems that have been explained in this background, it can be concluded that the influence of the physical environment on the quality of life of diabetes mellitus sufferers requires more attention so that researchers are interested in conducting research on the influence of the physical environment on the quality of life of Type 2 DM sufferers in the Belawan Community Health Center area to find out. The influence of the physical environment on the quality of life of type 2 diabetes mellitus patients in the Belawan Community Health Center area.

METHOD

This study used a quantitative approach using a questionnaire and applied an analytical observational design with a cross-sectional method. Researchers obtained primary data through the WHOQOL-BREF questionnaire and home physical environment checklist questionnaire measurements using a tape measure, Lux meter, and hygrometer

conducted from April to May 2025 at the homes of residents with Type 2 Diabetes Mellitus in the working area of the Belawan Community Health Center. The WHOQOL-BREF instrument used in this study has undergone an adaptation and validation process in Indonesian by the Research and Development Agency of the Ministry of Health of the Republic of Indonesia. The Indonesian version has been widely used in health research in Indonesia, including in populations with chronic diseases such as type 2 diabetes mellitus. The validity and reliability of this instrument have been proven adequate, with Cronbach Alpha values ranging from 0.70-0.87 across all main domains (physical, psychological, social, and environmental), indicating good internal consistency for assessing quality of life in the Indonesian cultural context.

Inclusion criteria included Type 2 DM patients aged ≥18 years, permanently residing in the study area, able to communicate in Indonesian, and willing to be respondents. Exclusion criteria included patients with severe complications, mental disorders, or being hospitalized. The study population consisted of 226 people, with a sample size of 70 respondents determined using the Slovin formula (margin of error 10%, confidence level 90%). This formula was chosen considering resource limitations and the homogeneity of population characteristics. The researchers acknowledge that more robust sampling methods such as stratified random sampling may be considered in future research. This study has obtained ethical approval from the Health Research Ethics Commission (KEPK) of Prima Indonesia University with registration number 1271012S registered/accredited.

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RESULTS

Table 1 Frequency Distribution of Respondents Based on Ventilation, Humidity, Ceiling Height, Lighting, and Quality of Life of Type II DM Patients

Variables	N	%
A. Independent Variables		
Bedroom Ventilation		
Not eligible	42	60.0
Qualify	28	40.0
Living Room Ventilation		
Not eligible	24	34.3
Qualify	46	65.7
Bedroom Humidity		
Not eligible	50	71.4
Qualify	20	28.6
Living Room Humidity		
Not eligible	29	41.4
Qualify	41	58.6
Bedroom Ceiling Height		
Not eligible	33	47.1
Qualify	37	52.9
Living Room Ceiling Height		
Not eligible	20	28.6
Qualify	50	71.4
Bedroom Lighting		
Not eligible	45	64.3
Qualify	25	35.7
Living Room Lighting		
Not eligible	27	38.6
Qualify	43	61.4
b. Dependent Variable		
Quality of Life		

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Variables	N	%
Not eligible	53	75.7
Qualify	17	24.3
Total	70	100

Based on table 1, it can be seen that of the 70 highest respondents in the Bedroom Humidity Variable, the majority did not meet the requirements as many as 50 people (71.4%) and the minority met the requirements as many as 20 people (28.6%), and the Family Room Ceiling Height Variable, the majority met the requirements as many as 50 people (71.4%), and the minority did not meet the requirements as many as 20 people (28.6%). Meanwhile, in the Quality of Life Variable, the majority of respondents were not good, namely 53 people (75.7%) and the minority were good, namely 17 people (24.3%).

Table 2 Relationship between ventilation, humidity, ceiling height and lighting on the quality of life of type 2 diabetes patients.

Variables	Category	Quality of Life				p - Value
		Not satisfactory		Satisfying		
		N	%	N	%	
Bedroom Ventilation	Not eligible	40	95.2	2	4.8	0.000
	Qualify	13	46.4	15	53.6	
Living Room Ventilation	Not eligible	23	95.8	1	4.2	0.005
	Qualify	30	65.2	16	34.8	
Bedroom Humidity	Not eligible	42	84	8	16	0.015
	Qualify	11	55	9	45	
Living Room Humidity	Not eligible	25	86.2	4	13.8	0.085
	Qualify	28	68.3	13	31.7	
Bedroom Ceiling Height	Not eligible	31	93.9	2	6.1	0.001
	Qualify	22	59.5	15	40.5	
Living Room Ceiling Height	Not eligible	19	95	1	5	0.028
	Qualify	34	68	16	32	
Bedroom Lighting	Not eligible	41	91.1	4	8.9	0.000

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	Qualify	12	48	13	52	
Living Room Lighting	Not eligible	26	96.3	1	3.7	0.001
	Qualify	27	62.8	16	37.2	

Based on table 2, it is known that the results of the chi square bivariate test obtained a value of p = 0.000 p < α) α = 0.05 (Bedroom and family room ventilation, bedroom humidity, bedroom and family room ceiling height, bedroom and family room lighting), this means that there is a significant relationship with the quality of life of type 2 DM sufferers in the Belawan Community Health Center work area, while the results are not related or p > α = 0.05, namely the family room humidity variable.

Table 3 Multivariate

Variables	P (≤ 0.025)	Odds Ratio	95% Confidence Interval
Bedroom Ventilation	0.036	9,582	1,166 - 78,778
Living Room Ventilation	0.524	2,313	0.175 - 30.525
Bedroom Humidity	0.735	1,319	0.265 - 6.553
Bedroom Ceiling Height	0.391	2,311	0.341 - 15.659
Bedroom Lighting	0.861	0.820	0.089 - 7.532
Living Room Lighting	0.338	3,727	0.253- 54,971

Prior to the multivariate logistic regression analysis, multicollinearity between the independent variables was tested using the Variance Inflation Factor (VIF). The test results showed that all variables had VIF values <10, indicating no significant multicollinearity among the independent variables in the model.

To assess the suitability of the logistic regression model used, a goodness-of-fit test was performed using the Hosmer-Lemeshow test. The test results showed a p-value of 0.631, indicating that the logistic regression model had a good fit with the data (there was no significant difference between the observed values and the values predicted by the model).

DISCUSSION

It was found that cases of inadequate bedroom ventilation were also high at the Rejo Sari Health Center in Pekanbaru City, amounting to 62 people (53%) and living room ventilation as many as 64 respondents (54.7%) [10] . In theory, good ventilation has a floor area of 10% of air flow in both the bedroom and living room, affecting the quality of life of the occupants. Adequate ventilation helps maintain optimal room temperature and can provide comfort for Type 2 DM sufferers [11] .

In the variable between Bedroom Humidity and Quality of Life of Type 2 DM Sufferers, there is a significant relationship with a p-value = (0.015 < 0.05). This result is in line with research [12] where it was found that in research with a p-value of 0.038 < 0.05% which means there is a relationship between humidity temperature and sleep quality of Type 2 DM sufferers. And in research [13] , where bedroom humidity is related to the quality of life of Type 2 DM sufferers with a p-value of 0.000 < α (0.05) which shows that the condition of the bedroom environment affects physiological aspects such as sleep quality and blood sugar levels of Type 2 DM sufferers. Inappropriate humidity can trigger increased blood sugar levels and sleep disorders which can ultimately have a negative impact on the quality of life of Type 2 DM sufferers.

Meanwhile, the variable of family room humidity with the quality of life of Type 2 DM patients obtained a P-value = (0.085>0.05), this shows that there is no significant relationship between family room humidity and the quality of life of Type 2 DM patients. This is in line with research [14] which states that there is no significant relationship between family room humidity and quality of life with a p-value of 0.886>0.05. However, this is not in line with the mini-research conducted [15] which states that humidity has a relationship with indoor air quality, the use of large windows can be a natural solution to repel humidity that can affect health.

In the Bedroom Ceiling Height with the Quality of Life of Type 2 DM Sufferers with p-value = (0.001 < 0.05) this shows a relationship between the two. And the results of the bivariate analysis of the Family Room Ceiling Height using chi-square obtained a P-value = (0.028 < 0.05) where there is a significant relationship between the Family Room Ceiling Height and the Quality of Life of Type 2 DM Sufferers. Based on the article [16] explains that the height of the ceiling in the room plays an important role in creating comfort and quality of life, including for Type 2 DM sufferers. The living room and bedroom are the centers of activity of the occupants. Therefore, the ceiling in these two rooms is made higher, around 3 meters. In the article [17] it is also stated that the higher the ceiling in a room (bedroom, living room, bathroom, and kitchen), allows for smoother air circulation and a cooler room temperature, thereby increasing the comfort of the occupants.

Based on table 2 Bedroom Lighting Quality of Life of Type 2 DM Patients, the P value is obtained = (0.001 < 0.05), this shows that there is a significant relationship between bedroom lighting and Quality of Life of Type 2 DM Patients. In the family room lighting with the quality of life of Type 2 DM patients, the P value = (0.001 < 0.05) shows that there is a significant relationship between family room lighting and quality of life of Type 2 DM patients.

Based on this study, the bedroom lighting variable has the same relationship as the study [18] , where a p-value of 0.004 was found with an OR = 3.332, which means it has a strong relationship with a risk 3 times greater. And the living room lighting variable in the study [18] , where a p-value of 0.005 was found with an OR = 3.157, which means it has a strong relationship with a risk 3 times greater and in the study [19] , which has a p-value = 0.016, it was found that there is an influence/relationship between lighting and the patient's quality of life.

In multivariate analysis, it was found that the bedroom ventilation variable had OR = 9.582, which means that bedroom ventilation is a 9-fold risk factor for Type 2 DM.

Statistically, OR > 1 indicates that bedroom ventilation has a strong positive relationship between poor ventilation in the bedroom and an increased likelihood of someone suffering from type 2 diabetes. In theory, good ventilation has a floor area of 10%, air flow in the bedroom and living room affects the quality of life of the occupants. Adequate ventilation helps maintain optimal room temperature and can provide comfort for patients with type 2 diabetes. [11] .

However, it should be noted that the OR value of 9.582 for the bedroom ventilation variable is accompanied by a fairly wide confidence interval (95% CI: 1.166-78.778), indicating a low level of precision. This is most likely due to the limited sample size (n=70) and the uneven distribution of categories. Therefore, these findings should be interpreted with caution, and further research with a larger sample size is recommended to obtain more accurate estimates. Furthermore, it is important to emphasize that the relationship found in this study is an association, not a causal relationship, given the cross-sectional study design used. This design does not allow for a definite time sequence between exposure and outcome. In multivariate analysis, it was found that the Living Room and Bedroom Lighting variables had (OR = 3.727; OR = 0.820) which means that living room lighting is a 3-fold risk factor for the occurrence of Type 2 DM. Statistically, OR > 1 indicates that living room lighting has a strong positive relationship between poor lighting in the living room and an increased likelihood of someone suffering from type 2 diabetes, while lighting in the bedroom has OR < 1 which is a protective factor.

Other studies also support this finding, where exposure to bright light at night, especially between 12:30 and 6:00 a.m., is associated with an increased risk of type 2 diabetes. High nighttime light exposure can disrupt the body's circadian rhythm, which plays an important role in regulating insulin secretion and glucose metabolism. This disruption of the circadian rhythm can cause insulin resistance and glucose intolerance, thereby increasing the risk of type 2 diabetes [20] . In addition, excessive nighttime light

exposure can also disrupt sleep quality, which can chronically increase the risk of type 2 diabetes through mechanisms such as increased cortisol levels, appetite, and inflammation [12] .

CONCLUSION AND RECOMMENDATIONS

Based on the results of this study, it can be concluded that there is a statistically significant relationship (association) between physical environmental conditions (bedroom ventilation, bedroom humidity, ceiling height, and lighting) and the quality of life of Type 2 Diabetes Mellitus patients in the Belawan Community Health Center area. However, because this study design is cross-sectional, the relationship found is associative, not causal. The most dominant factors related to quality of life are bedroom ventilation and living room lighting. Belawan Community Health Center is advised to begin integrating home environment screening as part of its promotive and preventive services for type 2 diabetes patients. This can be done through home visits or simple questionnaire-based interviews that assess ventilation, lighting, and humidity. The Community Health Center can also develop a healthy environment education program, for example in the form of regular counseling or visual educational media, to increase public awareness of the importance of the physical home environment for the comfort and quality of life of diabetes sufferers. People are advised to actively improve ventilation and lighting in their homes, for example by opening windows regularly or using thin curtains to allow natural light in but still feel comfortable. For future research, it is recommended to use longitudinal or experimental designs to examine possible causal relationships between the physical environment and quality of life in people with diabetes.

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