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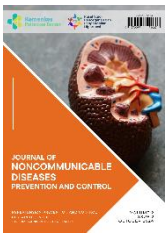

Research Article

DIABETES MEDICATION EDUCATION AND DIABETES MEDICATION ADHERENCE IN INDONESIA IN 2023: INDONESIA HEALTH SURVEY (SURVEI KESEHATAN INDONESIA)

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ABSTRACT

Diabetes Mellitus (DM) is one of the metabolic diseases that is among the four leading causes of death in Indonesia. Uncontrolled blood glucose levels in diabetes mellitus patients can lead to serious complications. One effort to prevent complications of diabetes mellitus is to enhance adherence to optimize medication programs. The objective of this study is to provide an overview of diabetes patients who receive education related to diabetes medication and adherence to diabetes medication in Indonesia, as well as to determine the relationship between receiving diabetes medication education and medication adherence among diabetes patients in Indonesia. The data used in this study is from the 2023 Indonesian Health Survey (SKI), which includes data on respondents who received diabetes medication education and data on medication adherence in 38 provinces in Indonesia. The analytical method employed is logistic regression, analyzed on RStudio version 4.4.0. Medication adherence is categorized into two binary categories: provinces with higher adherence and provinces with lower adherence, with the categorization threshold using the mean of medication adherence data. The frequency distribution results show 21 provinces with adherence above the mean and 17 provinces below the mean. The logistic regression results showed the estimated log odds of medication adherence was -15.67, the estimate for receiving diabetes medication education was 0.1907, with adjusted odds ratio 1.21, and p-value <0.001, indicating that, compared to an alpha value of 0.05, diabetes medication education is significantly related to medication adherence among diabetes patients in Indonesia.

Kata Kunci
Diabetes melitus
Pendidikan kesehatan
Kepatuhan obat
Gangguan metabolik

ABSTRAK

Diabetes Melitus (DM) adalah salah satu penyakit metabolik yang merupakan salah satu dari empat penyebab utama kematian di Indonesia. Kadar glukosa darah yang tidak terkontrol pada pasien diabetes melitus dapat menyebabkan komplikasi serius. Salah satu upaya pencegahan komplikasi diabetes melitus adalah dengan meningkatkan kepatuhan untuk mengoptimalkan program pengobatan. Tujuan dari penelitian ini adalah untuk memberikan gambaran tentang pasien diabetes yang menerima edukasi terkait pengobatan diabetes dan kepatuhan terhadap pengobatan diabetes di Indonesia, serta untuk mengetahui hubungan antara pendidikan penerimaan obat diabetes dengan kepatuhan pengobatan di kalangan pasien diabetes di Indonesia. Data yang digunakan dalam penelitian ini berasal dari Survei Kesehatan Indonesia (SKI) 2023, yang meliputi data responden yang mendapatkan edukasi pengobatan diabetes dan data kepatuhan pengobatan di 38 provinsi di Indonesia. Metode analitik yang digunakan adalah *logistic regression*, dianalisis pada RStudio versi 4.4.0. Kepatuhan pengobatan dikategorikan ke dalam dua kategori biner: provinsi dengan kepatuhan lebih tinggi dan provinsi dengan kepatuhan lebih rendah, dengan ambang batas kategorisasi menggunakan rata-rata data kepatuhan pengobatan. Hasil distribusi frekuensi menunjukkan 21 provinsi dengan kepatuhan di atas rata-rata dan 17 provinsi di bawah rata-rata. Hasil *logistic regression* menunjukkan estimasi log odds kepatuhan pengobatan sebesar -15,67, estimasi penerimaan edukasi pengobatan diabetes sebesar 0,1907, dengan *adjusted odds ratio* 1,21, dan p-*value* <0,001, menunjukkan bahwa, dibandingkan dengan nilai alfa 0,05, edukasi pengobatan diabetes secara signifikan berhubungan dengan kepatuhan pengobatan pada pasien diabetes di Indonesia.

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INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disease caused by impairments in insulin function, insulin secretion, or both (Purwanti *et al*., 2023). In Indonesia, diabetes is a significant non-communicable disease (NCD), ranking as one of the top four causes of death alongside cardiovascular diseases (including stroke), cancer, and chronic obstructive pulmonary disease (COPD) (Kementerian Kesehatan Republik Indonesia, 2024). The diagnosis of diabetes is determined based on a physician's diagnosis and fasting blood glucose levels of ≥126 mg/dl or 2-hour postprandial blood glucose levels of ≥200 mg/dl, according to the criteria of the Association of Indonesian Endocrinology (Perkumpulan Endokrinologi Indonesia, 2021).

Indonesia is the country with the fifth largest number of diabetics in the world (Agustina *et al*., 2023). The prevalence of diabetes based on physician diagnosis has increased compared to the 2018 Basic Health Research (Riskesdas) results, rising from 1.5% in 2018 to 1.7% in 2023 across all age groups, and from 2.0% in 2018 to 2.2% in 2023 among those aged ≥15 years. The three provinces with the highest prevalence of diabetes based on physician diagnosis in 2023 are the Special Capital Region (DKI) of Jakarta, the Special Region (DI) of Yogyakarta, and East Kalimantan Province. Conversely, the lowest prevalence was identified in East Nusa Tenggara, Papua, and Maluku Provinces (Kementerian Kesehatan Republik Indonesia, 2019, 2024).

The 2023 Indonesia Health Survey (Survei Kesehatan Indonesia) revealed that the prevalence of diabetes based on physician diagnosis in the productive age group was 1.6%, with only 1.5% (91.3% of those diagnosed) receiving medication (either oral or injectable medication). In the elderly age group, out of 6.5% identified with diabetes based on physician diagnosis, only 6.1% (93.2% of those diagnosed) were undergoing medication (oral or injectable medication) (Kementerian Kesehatan Republik Indonesia, 2024).

Preventing diabetes requires maintaining good control of blood sugar levels and using medications correctly and promptly, which may need to be sustained throughout a person's life (Mannan *et al*., 2021). Uncontrolled blood glucose levels in individuals with diabetes mellitus can lead to serious complications. One effort to prevent diabetes mellitus complications is to enhance adherence to optimize medication programs (Roziqi *et al*., 2024). Medication adherence refers to how well individuals follow their healthcare provider's instructions regarding the timing, dosage, and frequency of their medication over the prescribed duration (Huang *et al*., 2020). The risks of complications due to poor medication adherence in diabetes patients include acute metabolic complications such as diabetic ketoacidosis (DKA) or long-term vascular complications such as diabetic retinopathy, diabetic glomerulosclerosis, diabetic nephropathy, and peripheral neuropathy (Manasikana *et al*., 2024).

The objective of this research is to provide an overview of diabetes patients receiving education related to diabetes medication and medication adherence in Indonesia, as well as to determine the relationship between education and medication adherence among diabetes patients in Indonesia based on the 2023 Indonesian Health Survey data.

MATERIALS AND METHODS

The data utilized in this research is secondary data from the 2023 Indonesian Health Survey published by the Ministry of Health of the Republic of Indonesia. The Indonesian Health Survey generally provides an overview of health in Indonesia concerning indicators related to health status, healthcare services, health behaviours, and biomedical results from blood tests as well as dental and oral examinations (Badan Kebijakan Pembangunan Kesehatan & Kementerian Kesehatan Republik Indonesia, 2024).

Table 1 shows data on the proportion of individuals receiving diabetes medication education and medication adherence among residents of all ages who receive diabetes medication by province, as detailed in the non-communicable diseases chapter of the 2023 Indonesian Health Survey.

Table 1 The proportion of individuals receiving diabetes medication education and adherence to diabetes medication among residents by province

Province	Receiving Diabetes Medication Education	Adherence to Diabetes Medication	N Weighted
	%	%	
Aceh	76.3	87.4	261
Sumatera Utara	76.8	88.8	640
Sumatera Barat	89.5	88.7	205

Province	Receiving Diabetes Medication Education	Adherence to Diabetes Medication	N Weighted
	%	%	
Riau	83.8	90.8	286
Jambi	91.0	92.1	103
Sumatera Selatan	83.6	89.9	303
Bengkulu	87.9	92.8	64
Lampung	74.8	88.8	317
Bangka Belitung	83.2	89.4	96
Kepulauan Riau	63.5	94.0	106
DKI Jakarta	91.6	90.8	953
Jawa Barat	80.7	90.3	2,439
Jawa Tengah	78.4	86.8	2,002
DI Yogyakarta	80.8	88.0	315
Jawa Timur	80.1	88.5	2,669
Banten	90.9	93.7	714
Bali	92.7	94.2	222
Nusa Tenggara Barat	72.6	91.4	225
Nusa Tenggara Timur	74.7	90.5	114
Kalimantan Barat	85.3	93.7	197
Kalimantan Tengah	82.7	88.7	112
Kalimantan Selatan	81.3	87.0	165
Kalimantan Timur	80.5	87.0	259
Kalimantan Utara	87.7	90.7	33
Sulawesi Utara	81.2	92.3	165
Sulawesi Tengah	77.9	91.5	141
Sulawesi Selatan	81.9	90.7	402
Sulawesi Tenggara	67.6	91.8	90
Sulawesi Gorontalo	81.5	94.8	65
Sulawesi Barat	79.9	95.7	42
Maluku	70.2	86.3	35
Maluku Utara	81.2	93.9	31
Papua Barat	82.6	90.1	18
Papua Barat Daya	92.0	88.4	19
Papua	82.3	84.1	38
Papua Selatan	76.1	87.6	16
Papua Tengah	86.5	82.5	27
Papua Pegunungan	100	92.6	3
Indonesia	**81.4**	**89.5**	**13,891**

Data analysis was conducted using the statistical software RStudio version 4.4.0. The method employed was logistic regression. Logistic regression is a statistical method used to examine the connection between one or more predictor variables (which can be either categorical or continuous) and a binary outcome (dichotomous) (Ranganathan *et al.*, 2017). In this research, adherence to diabetes medication as the outcome variable was categorized into provinces with higher adherence and provinces with lower adherence using the mean as the threshold point. Receiving diabetes medication education is the predictor variable (continuous). The logistic regression analysis in RStudio was performed using the "glm" command.

RESULTS AND DISCUSSION

Summary of receiving diabetes medication education and adherence to diabetes medication data

Table 2 shows the summary of data on receiving diabetes medication education and medication adherence.

Table 2 The summary of receiving diabetes medication education data

	Min.	1st Qu.	Mean	Median	3rd Qu.	Max.
Receiving Diabetes Medication Education	63.50	78.03	81.40	81.88	86.20	100.00
Adherence to Diabetes Medication	82.50	88.42	90.40	90.17	92.25	95.70

From the descriptive statistics, the variable receiving diabetes medication education, which represents the percentage of individuals receiving education, had a minimum value of 63.5% and a maximum value of 100%. The median of receiving diabetes medication education was 81.4%, and the mean was approximately 81.88%, indicating a relatively high level of receiving diabetes medication education across the sample. The interquartile range (IQR) for receiving diabetes medication education spanned from 78.03% (1st quartile) to 86.2% (3rd quartile), suggesting moderate variability around the middle values.

For medication adherence, the adherence rates varied from a minimum of 82.5% to a maximum of 95.7%, with a median of 90.4% and a mean of 90.17%. These values highlight that adherence rates were generally high within the sample. The IQR for adherence ranged from 88.42% (1st quartile) to 92.25% (3rd quartile), indicating that most adherence rates were concentrated in this range.

Table 3 shows the province with the lowest and highest in receiving diabetes medication education and adherence to diabetes medication.

Table 3 The province with the lowest and highest in receiving diabetes medication education and adherence to diabetes medication

	Receiving Diabetes Medication Education	Adherence to Diabetes Medication
Lowest Province	Kepulauan Riau (63.5%)	Papua Tengah (82.5%)
Highest Province	Papua Pegunungan (100.0%)	Sulawesi Barat (95.7%)

Based on the data shown above, the province with the lowest in receiving diabetes medication education is Kepulauan Riau and the highest is in Papua Pegunungan, while the province with the lowest adherence to diabetes medication is Papua Tengah and the highest is in Sulawesi Barat. The box plot is shown in **Figure 1**.

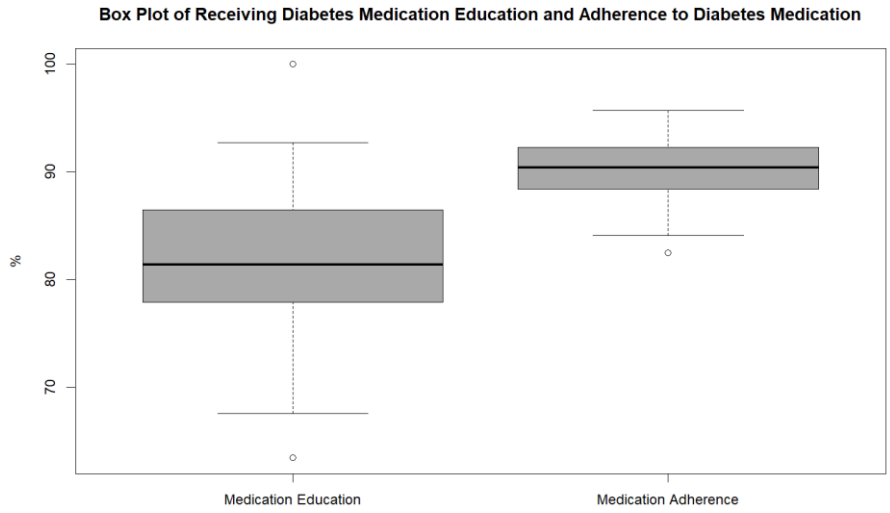

Figure 1 Box plot of receiving diabetes education and adherence to diabetes medication

Table 4 shows the summary of medication adherence data. Adherence to diabetes medication turned into the province with higher medication adherence and province with lower medication adherence outcome: if adherence was over 90%, it was considered a "higher medication adherence" (coded as 1), otherwise if adherence was below 90% "lower medication adherence " (coded as 0). This higher-or-lower medication adherence measure to see how it relates to receiving diabetes medication education.

Table 4 The summary of medication adherence binary data

	Higher medication adherence		Lower medication adherence		Total	
	n	%	n	%	N	%
Medication adherence	21	55.3	17	44.7	38	100

Out of the 38 provinces observed in the dataset, 21 observations (approximately 55.3%) fall into the high adherence category, while the remaining 17 observations (approximately 44.7%) are in the low adherence category. This distribution indicates that a slightly larger proportion of the sample has high adherence levels.

Table 5 shows the list of provinces under the categories of higher medication adherence and lower medication adherence.

Table 5 The list of provinces with higher and lower medication adherence

	Higher medication adherence	Lower medication adherence
Province	Riau	Aceh
	Jambi	Sumatera Utara
	Bengkulu	Sumatera Barat
	Kepulauan Riau	Sumatera Selatan
	DKI Jakarta	Lampung
	Jawa Barat	Bangka Belitung
	Banten	Jawa Tengah
	Bali	DI Yogyakarta
	Nusa Tenggara Barat	Jawa Timur
	Nusa Tenggara Timur	Kalimantan Tengah
	Kalimantan Barat	Kalimantan Selatan
	Kalimantan Utara	Kalimantan Timur
	Sulawesi Utara	Maluku
	Sulawesi Tengah	Papua Barat Daya
	Sulawesi Selatan	Papua
	Sulawesi Tenggara	Papua Selatan
	Sulawesi Gorontalo	Papua Tengah
	Sulawesi Barat	
	Maluku Utara	
	Papua Barat	
	Papua Pegunungan	
Total	21 Provinces	17 Provinces

Logistic Regression Model Results

Table 6 represents the logistic regression model results to examine the relationship between receiving diabetes medication education and adherence rates, a logistic regression model was estimated using adherence binary as the outcome variable. In this model, medication adherence binary data was defined as 1 for higher medication adherence rates greater than 90% and 0 for lower medication adherence. The predictor variable was receiving diabetes medication education, and the model was weighted by the N-weighted variable to account for different sample sizes across observations.

Table 6 Result of the logistic regression model

Predictor	Estimate	Std. error	z-value	p-value	aOR
(Intercept)	-15.669	0.376	-41.71	<0.001	-
Receiving Diabetes Medication Education	0.191	0.005	41.20	<0.001	1.21

The logistic regression model summary provides insight into the relationship between the predictor receiving diabetes medication education and the medication adherence binary outcome, where the medication adherence binary indicates higher or lower adherence based on whether adherence scores are greater than 90. The results from the logistic regression showed that receiving diabetes medication education is a significant predictor of medication adherence. First, we looked at what happens without considering receiving diabetes medication education. The intercept indicates the estimated log odds of medication adherence when receiving diabetes medication education is zero. The result for the intercept was -15.67. This very negative number suggests that, without including receiving diabetes medication education in the model, the likelihood of someone having a high adherence rate (above 90%) is extremely low. In other words, people who receive little diabetes medication education have a low chance of meeting that high adherence threshold.

When we added receiving diabetes medication education to the model, we found that the estimate for receiving diabetes medication education was 0.1907. This number represents the effect of receiving education on medication adherence. To make it easier to understand, we converted this estimate into an adjusted odd ratio (aOR), which came out to about 1.21. This means that for every increase in receiving education, the odds of having high adherence improve by about 21%. This means that for every one-unit increase in receiving education, the odds of adherence exceeding 90% increase by 21%. While this effect is statistically significant ($p < 0.001$), its magnitude suggests that receiving education alone is not a strong predictor of adherence.

In summary, the results show that receiving higher diabetes medication education is associated with better adherence, but it's not the only factor influencing adherence rates. Receiving education plays a significant role, but there are likely other variables that also impact whether individuals achieve high adherence. Thus, the results of this study should be interpreted with caution since this study does not capture all relevant aspects of adherence such as demographic variables, motivations for adherence, and external factors. Future research should further explore other factors to better assess adherence to diabetes medication. Despite the limitations, this study can be used as an insight to develop a health education and promotion program related to diabetes mellitus to increase medication adherence.

In a similar study conducted in Dubai, the United Arab Emirates (UAE), among 761 participants, 76% had good knowledge and attitude toward their diabetes with adherence to medication for about 70% demonstrating a strong association between intensive education service being given with better practice and outcome of the disease including medication adherence (Abdulrahman *et al*., 2020). With high medication adherence, diabetic patients can control their blood glucose level and health quality can remain stable (Purwanti *et al*., 2023)

Additionally, in a study conducted in Sudan, among 213 individuals recruited for the study, only 15% of them showed high medication adherence with the barriers to medication adherence being due to the medication side effects (18.3%), the use of herbal medicine (12.3%), and unavailability of medication (7%), where inadequate education had a high contribution in predicting this medication adherence (Badi *et al*., 2020). Challenges stemming from inadequate adherence to treatment can deteriorate the impact of diabetes, leading to poor health outcomes, reduced quality of life, and increased healthcare expenses (Ranjbaran *et al*., 2020).

On the other hand, on a smaller scale, a study in a public health centre in Kalimantan, Indonesia with a total respondent of 67 respondents demonstrated no significant relationship between the experience of getting diabetes medication education with medication adherence. This could be due to respondents being dominated by the age range of DM patients above 45 years where cognitive ability to receive information has decreased. However, adherence to consuming medication is the key to success in controlling blood sugar in diabetic patients. Therefore, increasing knowledge through education about diabetes management still needs to be done (Baedlawi *et al*., 2023).

CONCLUSION

In conclusion, the logistic regression analysis demonstrated a significant positive association between receiving diabetes medication education and medication adherence among residents of all ages who receive diabetes medication in Indonesia. Higher percentages of receiving diabetes medication education are associated with increased odds of high medication adherence, highlighting the importance of education in diabetes medication. Thus, these results can be used to establish an educational program or campaign on diabetes related to its nature of disease, adherence, and medication to raise the awareness of diabetic patients. However, the results show that while receiving diabetes medication education does have a statistically significant relationship with adherence, its practical effect is limited. The model itself does not capture all relevant aspects of adherence, suggesting that additional variables like demographic variables, motivations for adherence, and external influences might be necessary to be considered to capture the dynamics of adherence better.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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