INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES
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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v12-i5/12973 DOI:10.6007/IJARBSS/v12-i5/12973

Received: *13* March 2022, ***Revised:*** *15* April 2022, ***Accepted:*** *30* April 2022

Published Online: *10* May 2022

In-Text Citation: (Mohamed et al., 2022)

To Cite this Article: Mohamed, N. F., Tajuddin, N. A. A., Nizam, F. H. M., Zakaria, N., & Amin, N. A. F. M. (2022). The Relationships between Depression and Physical Activity with Medication Adherence among Patients with Type 2 Diabetes Mellitus in Klang Valley, Malaysia. *International Journal of Academic Research in Business and Social Sciences. 12(5),* 1982– 1995.

Vol. 12, No. 5, 2022, Pg. 1982– 1995

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The Relationships between Depression and Physical Activity with Medication Adherence among Patients with Type 2 Diabetes Mellitus in Klang Valley, Malaysia

Nor Firdous Mohamed[1], Nur Amani Ahmad Tajuddin[2], Faridah Hamimi Mohammad Nizam[3], Norfaezah Zakaria[1], Nur Aina Fatihah Mohd Amin[1]

[1]Department of Psychology and Counselling, Faculty of Human Development, Universiti Pendidikan Sultan Idris, Perak, Malaysia, [2]Department of Primary Care Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia, [3]Department of Psychology, AbdulHamid AbuSulayman Kulliyyah of Islamic Revealed Knowledge and Human Sciences, International Islamic University Malaysia, Kuala Lumpur, Malaysia
Corresponding Author's Email: norfirdous@fpm.upsi.edu.my

Abstract
Studies among the Type 2 Diabetes Mellitus (T2DM) patients have shown that optimal mental health status is associated with better medication adherence leading to a good blood glucose control. This research aims to determine the relationship between psychological well-being and physical activity levels with medication adherence among the T2DM patients. A cross-sectional study was conducted on 240 diabetic patients at an outpatient primary care clinic from a tertiary teaching hospital in Klang Valley, Malaysia. The questionnaires used in the study were Medication Compliance Questionnaire (MCQ), Hospital Anxiety and Depression Scale (HADS), and Godine-Shephard Leisure-Time Physical Activity Questionnaire (GSLTPAQ). The research hypotheses were tested by the Pearson Chi-Square Test of Independence. Physical activity shows a non-significant relationship with medication adherence Concur with the previous study, depression is one of the crucial factors that correlate with poor medication adherence among diabetic patients in Malaysia. There is a statistically significant relationship between poor medication adherence with depression. Thus, appropriate psychological assessment must be offered to all T2DM patients as part of the treatment management in all Malaysian primary care services. This study proves that in managing a patient with T2DM, psychological well-being must be addressed at follow-ups by the attending doctor to ensure a favourable patient outcome and to reduce morbidity.
Keywords: Psychological Well-Being, Depression, Physical Activity, Medication Adherence, Diabetes.

Introduction

Type 2 Diabetes Mellitus (T2DM) is a global health crisis that threatens all nations' economies, particularly developing countries (Hu, 2011). A recent study suggests that countries like China, India (Hu, 2011), large parts of the Asian country such as Africa and Latin America (Unnikrishnan & Mohan, 2016) and Malaysia (Ibrahim, 2010) were among the leading country with the highest prevalence of diabetes patient. According to a report, an estimated 3.6 million Malaysians have diabetes. In contrast, another 1.8 million might be unaware of the disease as they never had the chance to do the health screening test properly, and unfortunately these numbers also were expected to increase (Bernama, 2019).

This article shows that the rising disease burden is not the only thing to be worried about, as the enormous hidden cost behind diabetes has severely impacted the overall cost of healthcare expenditure in Malaysia. With the number of increments in diabetes patients, a significant impact on health expenditure also increases. The evidence, shown in a study by Ismail et al (2017), found that the economic burden of T2DM in 2013 for hospitalised patients was MYR 195,627.67 (US$ 62,104), while those treated in the outpatient setting accounted up to MYR2,061,520.32 (US$ 654,450).

The main aim of diabetes treatment is to return blood sugar levels to a safe threshold and reduce the risk of diabetes complications while helping patients resume their daily functions (Felman, 2018). Previous studies have highlighted medication as one of the crucial sources of treatment in combating disease (Polonsky & Henry, 2016). According to Mesfin et al (2017), medication adherence is essential for patients with chronic diseases like T2DM. Higher medication adherence was associated with improved glycemic control, fewer emergency department (ED) visits, decreased hospitalisations, and lower medical costs (Capoccia et al., 2015).

While the importance is evident, not every person can adhere to medication. People with psychological distress have difficulty managing their own lives, not to mention chronic diseases such as diabetes, heart failure, and hypertension(Lin et al., 2004; Gonzalez et al., 2007). Pozzo et al (2016) found a high prevalence of depression in diabetes patients and this comorbidity influences adherence to medication. On the other hand, Alcántara et al. (2014) found that anxiety sensitivity is strongly associated with medication non-adherence among the TD2M that requires a multidisciplinary effort in adhering to the medication.

According to Shrivastava et al (2013), being physically active and having regular physical activity is one among seven essential self-care that produce an excellent outcome in diabetes patients. In addition, physical activity profoundly improved the physiologic and psychological conditions of those with diabetes mellitus (Jenkins & Jenks, 2017). Another study by Colberg et al (2016) believes that adopting and maintaining physical activity is critical for blood glucose management and overall health management among people with diabetes. To support the statement, Loprinzi (2015) found that physical activity may act as a catalyst to foster changes in health-seeking behaviours such as medication adherence.

There is a gap due to limited findings on understanding the psychological and physical factors among patients with TD2M in Malaysia. Thus, this study investigates the relationship between psychological distress and physical activity with medication adherence. The study's

findings aim to add more evidence-based references to create a better treatment management plan in Malaysian settings.

Literature Review

Medication Adherence among Diabetic Patients

The Type 2 Diabetes Mellitus (T2DM) patients need medication to control their blood sugar levels. However, many studies have found that positive outcome was seen in people with good adherence to their medication (Han et al., 2014; Kim et al., 2018). The research found that a lack of adherence to medication in diabetic patients causes suboptimal glycemic control and may lead to treatment failures, complications, and increased mortality (Khotkar et al., 2017). The findings suggested improving medication adherence by implementing counselling and health education in patients.

Similarly, Alqarni (2019) aimed to assess medication adherence among patients with diabetes and associated factors in one of the primary health care centres (PHCCs) in Saudi Arabia. These studies suggested how crucial adherence to medicines is for diabetes treatment to decrease mortality and morbidity. Interestingly, the study suggests that even when medications were given for free, the result still demonstrated poor medication adherence. Non-adherence to medication was associated with poor glycemic control, leading to worsening medical conditions, development of comorbidities, reduced quality of life, elevated health care costs, and increased mortality. Furthermore, according to Shiyanbola (2017), one out of seven essential self-management behaviours needed to achieve glycemic control for individuals with diabetes is being adherent to medication. Therefore, medication adherence is crucial in maintaining and managing diabetes.

Psychological Distress among Diabetic Patients

Anxiety and Medication Adherence among Diabetic Patients

Psychological distress in this research can be divided into two aspects: anxiety and depression. Both elements are psychological condition which is presumed to affect medication adherence. Krishna (2018) stated that being diabetic is stressful, and stress worsens diabetes. Diabetic patients have a significantly higher score for anxiety, depression, and stress than healthy participants. Having diabetes increases the prevalence to suffer from mental illnesses such as anxiety and depression.

The presence of anxiety is related to non-adherence to medication and poor diabetes, leading to diabetes complications. Recent study by Mendes, Martins, and Fernandes (2019) among older patients (≥ 65 years old) with a history of diabetes found that higher anxiety and depression were associated with non-adherence to medication. Huertas-Vieco et al (2014) found that while nonadherent patients have a significantly higher depression index than adherent patients, anxiety does not significantly correlate with adherence to pharmacological treatment.

Depression and Medication Adherence among Diabetic Patients

Emotional distress is widely known to affect people with diabetes. A study by Lin et al (2004) conducted on 4,463 patients with diabetes showed that major depression was associated with patient-initiated behaviours that are difficult to maintain, such as exercise, diet, and medication adherence. Gonzalez et al (2016) aimed to conduct a comprehensive assessment

of emotional distress with medication to examine their relationship over time. The study found that the somatic symptom of depression predicts non-adherence. -

Lunghi et al (2017) studied the impact of depression on medication adherence in patients with T2DM. The result showed that depression is an interdependent risk factor for antidiabetic (AD) non-adherence. Lunghi also suggested that patients with T2DM comorbid with depression might benefit from adherence-enhancing intervention. The findings on depression are consistent from year to year and highlight the consequences of depression on diabetic patients' medication adherence. This shows that intervention implementation might aid in the treatment process.

Physical Activity among Diabetic Patients

Numerous studies have been conducted, including physical activity as their main issue in the study. Most of the studies highlighted that exercise and physical activity are associated with a better quality of life and health outcomes. The advantages of physical activity are not limited to physical health but also benefit to emotional well-being. Physical activity is a modifiable risk factor for chronic diseases such as cardiovascular disease, diabetes, cancer, obesity, hypertension, and even for mental health conditions such as depression (Warburton, 2006).

Sadarangani et al (2014) conclude that moderate physical activity levels were associated with a better prognosis in diabetic adults. The study also recommended that clinical and public health services incorporate regular physical activity to manage diabetes. Interestingly, in 2019 the same researcher conducted intensive research on leisure-time physical activity with their metabolic control in both types of diabetic patients. Leisure-time physical activity is an efficient and inexpensive non-pharmacological tool for diabetes mellitus treatment (Sadarangani et al., 2019). Hence, healthcare professionals should educate and promote physical activity after early diagnosis to prevent disease-related complications (Sadarangani et al., 2014; Sadarangani et al., 2019).

Gordon & Nelson (2019) conducted a study on how physical activity correlates with T2DM in Jamaica. The study's objective was to determine the factors associated with physical activity in Jamaicans with T2DM. The study suggested that physical activity is an essential adjunct to drug therapy in the management of diabetes. Furthermore, Loprinzi, Sng & Frith (2017) also stated that exercise promoted and maximised patient medication adherence. Similarly, Jenkins & Jenks (2017) also suggest that physical activity instils habits of self-discipline in diabetic patients, which in turn enhances their compliance with treatment regimens (medications). To conclude, there are limited research studies on the importance of physical activity in treating T2DM patients. Therefore, this research will investigate the relationship between physical activities in enhancing better treatment for diabetic patients.

Research Method

Research Design

This is a cross-sectional survey applying the successive independent sample design method to collect the data from the Type 2 Diabetes Mellitus (T2DM) patients. Successive independent sampling is a method involves observing multiple random samples from a population over multiple time points (Sutton & Austin, 2018). According to Shaughnessy,

Zechmeister, and Zechmeister (2012), successive independent sample designs are cross-sectional surveys conducted over time (successively).

Population and Sample

Participants of this study were the Type 2 Diabetes Mellitus (T2DM) patients attending the outpatient primary care clinic from a tertiary teaching hospital in Klang Valley. Boateng et al. (2018) recommended a sample size between 180 and 300. Therefore, the researcher took the mean of both values and decided on 240 for the sample size of this study.

Instruments

Three questionnaires were used to collect the data and measure the key variables for this research. To understand the patient better; all three questionnaires were prepared in the bilingual version (English and Bahasa Malaysia).

The instruments used weres the Medication Compliance Questionnaire (Ahmad et al., 2012), The Hospital Anxiety and Depression Scaledeveloped by Zigmond and Snaith (1983), and Godin-Shephard Leisure-Time Physical Activity Questionnaire developed by (Godin and Shephard, 1985). Participants answered thedemographic information questionnaire consisting of information such as gender, age, race, marital status, working status, and route of medication intake.

Data Collection

The data collection started after consent was obtained from the participants that fulfilled the inclusion criteria. Most of the participants in this study had difficulty reading small letters and required help by reading the item, and participants responded to the most likeliness condition. These steps ensure a complete understanding of the participant and increase the reliability and validity of the data.

Data Analysis

Statistical Package for Social Sciences (SPSS) software version 23.0 were used for statistical data analysis. Two types of data analysis were conducted to explain the findingsdescriptive and inferential statistics. Descriptive statistic were applied to analyse the sociodemographic profile of the respondents. Inferential statistical analyses of the questionnaires and the associations between the variables and among items in the questionnaires were analysed by using Phi and Cramer's V analysis (Laerd Statistic, 2018).

Results

Sociodemographic profile of respondents

A total of 240 patients with Type 2 Diabetes Mellitus (T2DM) completed the questionnaires. The findings show that more female participants than male participants in the research study, with 54.6 and 45.4. The respondent's age varies hugely, ranging from 34 to 90 years old (M=64.43; SD=9.31). Majority of them were multi-ethnics races such as Malay (n=102; 42.5%), followed by Indian (n=98; 40.8%), Chinese (n=36; 15.0%), and the least were Other (n=4; 1.7%). The majority of the respondents were married (n=220; 91.7). As of working status, most of the patient was old and therefore currently not working (n=178; 74.2), while the other (n=62; 25.8%) were still working. Lastly, the route of medication intake of diabetes medication was categorized by Oral (n=156; 65.0%), Insulin Injection (n=73; 4.6%), or Both (n=11; 30.4%).

Descriptive analysis of all questionnaires suggested that the female participants were found to have higher adherence to diabetic medication (n=80; 61.1%), and more vulnerable to both anxiety (n=21; 16%) and depression (n=32; 24.4%) as compared to male participants. Among the respondents, both males and females scored highest in moderately active in physical activity with 46.8% and 51.1%, respectively. Leisure-Time Physical Activity Questionnaire found that both genders were the lowest in the active category of physical activity, with a percentage of 17.4 in males and 17.6 in females.

Table 1
Demographic Profile of Respondent

Demographic Factors		**N**	**(%)**
Gender			
	Male	109	45.4
	Female	131	54.6
Age			
	30 – 39 years old	2	0.8
	40 – 49 years old	12	5.4
	50 – 59 years old	51	21.3
	60 – 69 years old	103	42.9
	70 – 79 years old	64	26.7
	80 – 89 years old	6	2.6
	90 – 99 years old	1	0.4
Race			
	Malay	102	42.5
	Chinese	36	15.0
	Indian	98	40.8
	Other	4	1.7
Marital status			
	Married	220	91.7
	Divorced	13	5.4
	Single	7	2.9
Location			
	Urban	208	86.7
	Semi-urban	16	6.7
	Rural	16	6.7
Working status			
	Working	62	25.8
	Not working	178	74.2
Route of medication intake			
	Oral	156	65.0
	Insulin injection	11	4.6
	Both	73	30.4

The Relationship between Psychological Distress on Medication Adherence

Table 2 shows that the result from the Chi-Square Test between anxiety and medication adherence shows a value of (p=.14), suggesting that there is no significant difference between anxiety and medication adherence.

Table 2
Chi-Square Test between anxiety and medication adherence

	X^2	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.418	.143

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.20.

There was a difference in the relationship between anxiety and depression on medication adherence. Based on table 3, the relationship between depression and medication adherence shows a p-value of .000 with the Phi value coefficient (ϕ = -.4.2). Rea and Parker (1992) found that the phi value of 0.4 – 0.6 indicates a relatively strong relationship. Therefore, based on the chi-square analysis, depression is concluded to have a relatively strong negative relationship with medication adherence.

Table 3
Chi-Square Test between depression and medication adherence

	X^2	Asymptotic Significance (2-sided)
Pearson Chi-Square	42.351 [a]	.000

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 22.28.

Table 4
Strength of Association between depression and medication adherence

		Value	Approximate Significance
Nominal by Nominal	Phi	-.420	.000
	Cramer's V	.420	.000

The Relationship of Physical Activity Intensity on Medication Adherence

Table 5 shows that the association between physical activity and medication adherence exhibited a no significant relationship, denoted at p =.84. Thus, the hypothesis proposed by the researcher were rejected as no significant association were found between physical activity and medication adherence

Table 5
Chi-Square Test between physical activity and medication adherence

	X^2	Asymptotic Significance (2-sided)
Pearson Chi-Square	.343[a]	.842

a. 0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 17.33.

Discussions

Findings from this study suggest medication adherence was found higher in female participants than in male participants with theType 2 Diabetes Mellitus (T2DM). The existing findings are consistent with evidence by Imran and Plathottam (2017), which found that a more significant number of male diabetic patient was non-compliant with their medication.

Analysis using the Hospital, anxiety and depression scales (HADS) shows that both anxiety and depression are higher in female participants than males. Similarly, Demmer et al (2016), found higher levels of anxiety and depression symptoms to be positively related to the incident of diabetes among women but not among men. However, from the current study, we could infer that depression has impacted more diabetes patient than anxiety. As for physical activity, females and males are highest at being moderately active, followed by insufficiently active and the lowest category was active in physical activity. This finding was similar to a study by Chan et al. (2017), which stated that most of their respondent scored moderately in Physical Activity (PA) and the least were high PA.

The first proposed hypothesis was accepted as the researcher found a significant relationship between depression and medication adherence ($p = .000$, $\phi = -.4.2$). Depression was concluded to have a relatively strong negative relationship with medication adherence. This indicates that as depressive symptom increases, medication adherence decreases. The findings build on existing evidence of literature by Gonzalez and colleagues (2008), a statistically significant effect was revealed with moderate to a weak association ($r = .21$) between depression and self-care behaviour (including medication adherence). Similarly, Halepian (2018) found a significant negative association between adherence to diabetes treatment and diabetes distress. Our findings also show a remarkable resemblance with a previous study. For example, Snoek et al (2015) suggest depressive symptoms have a moderate to a strong relationship with poor adherence and glycemic outcomes among diabetes patients. On the other hand, the other psychological distress domain, anxiety, resulted in a non-significant relationship with medication adherence. Our findings are similar to previous research by Cruz de Sousa et al (2016), concluding that there are no statistically significant differences between compliance with medication treatment and anxiety disorder.

DiMatteo et al (2000) found that the association between anxiety and noncompliance was small and non-significant compared with depression. Current research could not provide clear reasons for the notable findings on depression and anxiety. However, previously mentioned researchers, DiMatteo et al (2000), proposed probable underlying reasons. For example, the nature of anxiety is heterogeneous ranging from panic, which has no relation to adherence, to obsessive-compulsive disorder and generalised anxiety disorder, which may improve compliance.. The researcher also mentioned the comorbidity effect of depression, which co-occur along with anxiety disorder. These reasons explain the differences between the two aspects of psychological distress with medication adherence. Depressive symptoms caused non-adherence, whereas anxiety did not profoundly affect medication among diabetic patients. This research provides considerable insight into medication adherence associated with mental health conditions like anxiety and depression.

Findings from the current study also highlighted a non-significant relationship between physical activity and medication adherence ($p = .84$, $p > 0.05$). This result indicates that physical activity is not associated with medication adherence in a diabetic patient.

This findings contradict previous research by Chew et al (2015) who has investigated the determinants of medication adherence among adults with type 2 diabetes at three public health clinics. The study found that patients who did not exercise were as adherent to medications as those who exercised more than three times per week. The similarities of this study are that the researcher denies the effect of physical activity on medication adherence. Hence, the current study provides a new insight that could address the adherence barrier from the physical activity; and primarily research based on Malaysia's local population.

The findings of this research could benefit the primary care services in government and private settings and society in general. This research found the relationship between psychological distress and physical activity on medication adherence. Thus, these findings can become references for primary care services with aims to enhance current treatment management. The psychological assessment should be considered an additional service to the patients in almost every follow-up session for the diabetic patients. Changes in their lifestyle and behaviour may contribute to adjustment issues and lead to depression and other psychological issues.

In another study, patients were advised to undertake self-management tasks, including diet, exercise self-monitoring, compliance with therapy, injection, medication, or both, and periodical consultation from clinic visits (Harvey, 2015). With the findings from this research, it is likely more favourable for future patient management to consider the psychological aspect of diabetes and physical activity management to ensure comprehensive advice and treatment for diabetes patients. For example, integrating cognitive, emotional, behavioural, and social factors into treatment intervention may improve treatment adherence among T2DM patients (Kalra, Jena & Yeravdekar, 2018). The primary outcome of treatment adherence intervention is beneficial to the Malaysian healthcare system, reducing medical expenditure and reducing the morbidity and mortality rates related to T2DM.

Conclusion

Medication adherence is vital in the process of maintaining and managing T2DM. Depression has a moderate association with medication adherence, but vice versa for anxiety. There is no association between physical activity and medication adherence. Hence, this study suggests depression as the important factor associated with medication adherence in diabetes patients. Therefore, it is crucial to study underlying psychological well-being and physical activity on medication adherence. The government and healthcare providers must provide an effort to incorporate psychological intervention into standard diabetes care treatment.

Acknowledgements

The authors would like to extend their gratitude to University Malaya Medical Center (UMMC). The research also was approved by the Medical Research Ethics Committee, MREC ID number: 201975-7616.

Corresponding Author
Nor Firdous Mohamed
Universiti Pendidikan Sultan Idris, Malaysia
Email: norfirdous@fpm.upsi.edu.my

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