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Prevalence and Factors Associated with Low Back Pain among Patients with Type 2 Diabetes Mellitus (T2DM)

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Abstract
This study investigated the prevalence and associated factors of low back pain (LBP) among T2DM. LBP was assessed using the Standardized Nordic Questionnaire, Wong-Baker Face Pain Scale for pain intensity and disability level was evaluated using the Revised Oswestry Low Back Pain Disability Questionnaire. 55.3% of the T2DM participants suffered LBP in the last 12 months. Employment status (X^2=4.088, p=0.043), education level (X^2=8.572, p=0.018) and fasting plasma glucose (FPG) level (X^2=6.381, p=0.041) were significantly associated with the occurrence of LBP. The current study found that the prevalence of LBP was high among T2DM patients.

Keywords: Low back pain; type 2 diabetes mellitus; prevalence; disability

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1.0 Introduction

Low back pain (LBP) is characterised as pain in the inferior margin of the 12th rib until the inferior gluteal folds (Hoy et al., 2010). It is a type of disorder that shows an increasing trend over time as a study by Wu et al. (2020) stated that the number of LBP sufferers rose to 577 million in 2017 from 377.5 million in 1990 globally. Furthermore, LBP is commonly reported with problems affecting the participation in activities of daily living, including routine functioning (Grabovac & Dorner, 2019). Besides, type 2 diabetes mellitus (T2DM) appears to be a significant problem affecting health worldwide (Al-Lawati, 2017). Globally, approximately 537 million people are living with diabetes in 2021, and the rate will be expected to increase to 643 million by 2030 (International Diabetes Federation, 2021). Moreover, the alarming trend of diabetes also could be seen in Malaysia. As stated by National Health and Morbidity Survey (2019), 1 in 5 Malaysian adults living with diabetes, and about 3.9 million adults in this country are people living with diabetes.

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Musculoskeletal problems are common in patients with diabetes (Ghosal & Ghosal, 2020), but the knowledge and information regarding the association of LBP in diabetic patients are few (Eivazavi & Abadi, 2012). Musculoskeletal problems such as LBP in T2DM patients are frequently neglected, and adequate attention was not given to this condition due to other diabetes-related complications such as nephropathy, neuropathy, retinopathy, foot ulcers, and coronary artery disease (Idowu et al., 2015).

Even though there is no exact pathophysiology that links the occurrence of LBP in T2DM, there is some mechanism that we could relate to these two conditions, such as there is evidence stating that abnormal collagen deposition in periarticular connective tissue in diabetic patients changes the structural matrix and tissues mechanical properties (Arkkila & Gautier, 2003). Advanced glycation endproducts (AGEs) that increase in diabetes patients with a high level of HbA1c could expedite spinal degeneration (Real et al., 2018). Apart from that, new evidence may link diabetes mellitus pharmacology treatment with the risk of musculoskeletal symptoms (Hassoon et al., 2017), which may contribute to developing LBP.

Studies on the link between LBP and T2DM are essential. Dario et al. (2017) stated that it is crucial to understand the potential risk factor between LBP and diabetes to optimize the treatment and include prevention measures in these two conditions. A limited study explores the LBP affecting disability in performing daily activities in T2DM patients. Nevertheless, none of the previous studies investigated the occurrence of LBP among T2DM conducted in Malaysia. Therefore, this study aims to identify the prevalence and associated factors with the severity of pain intensity and disability level due to LBP among T2DM patients in Klang Valley, Malaysia.

2.0 Literature Review

2.1 Diabetes

Musculoskeletal problems are conceivable on account of the multiple systemic nature of the disease (Bhat et al., 2016). According to Sozen et al. (2018), T2DM could lead to a variety of skeletal and muscular system complications. Some evidence proposed that it could cause by the macro- and microvascular complications associated with diabetes (Sozen et al., 2018). A cross-sectional study by Molsted et al. (2012) exhibited that musculoskeletal pain, including LBP, was more prevalent in T2DM patients compared to non-diabetic populations. Individuals with diabetes may experience various musculoskeletal issues that could lead to patients' discomfort, pain and dysfunction, thus negatively impacting the core treatment and worsening their quality of life (Sozen et al., 2018).

2.2 Prevalence

Even though the nature and magnitude of back pain and the association with T2DM remain unclear (Pozzobon et al., 2019), musculoskeletal pain, including LBP, frequently occurs in diabetic patients compared to the general population (Ghosal & Ghosal, 2020). Idowu et al. (2015) conducted a cross-sectional study on 143 diabetic patients and revealed a higher prevalence of self-reported LBP in T2DM patients (46.2%) compared to 143 healthy controls (31.5%). In the other hand, Iran population showed the similar finding with 63.4 % (Eivazi et al., 2012). In the United States, a study by Hassoon et al. (2017) collected data using National Health and Nutrition Examination Survey (NHANES) from 2009 to 2010 defined chronic LBP as the persistence of pain for three months. They found that 19.8% of diabetes adults have a chronic LBP, which appeared to be superior to adults without diabetes which was 12.9% and after the adjustment of risk factors of chronic LBP such as age, sex, level of education, race and income, the association between chronic LBP and diabetes remained significant.

3.0 Methodology

3.1 Participants and Procedures

This cross-sectional study was conducted via an online survey through Google Form to collect data from T2DM respondents in Klang Valley, Malaysia. Participant recruitment was through a Google form link that was distributed through online platforms such as Whatsapp messenger, Telegram, Facebook, Instagram application and via email. Subsequently, consent was taken, and they could participate in this study voluntarily or refuse participation. Participants' inclusion criteria were at least two years diagnosed with T2DM, age above 20 years old and Selangor and Kuala Lumpur residents. At the same time, participants who had LBP due to significant trauma, car accident, or lumbar ache due to any known other pathological condition were excluded from participating in this study. Two hundred twenty-two responded and completed the questionnaire; however, only 161 subjects were eligible and included in this study. This study was approved by the Research Ethics Community (REC) Universiti Teknologi MARA (UiTM) reference number REC/08/2021 (UG/MR/741).

3.2 Measures

Respondents need to fill in their sociodemographic data in the first section. LBP occurrence in the second section was assessed using the Standardized Nordic Questionnaire (SNQ) to determine whether they have suffered pain in the area of their lower back in the last 12 months and last seven days (Kuorinka et al. 1987). The Malay version of SNQ was used in the study by Nur Azma et al. (2016). Only T2DM participants that had reported LBP in the last 12 months and seven days proceeded to the last section. Wong-Baker Face Pain Scale was used to measure the severity of LBP intensity (Wong-Baker Face Pain Scale, n.d.).The tool consists of a picture scale that describes how the subjects feel due to the pain due to lower back problems. As this type of pain measurement is easy to understand, simple and useful (Eivazi & Abadi, 2012), it is suitable for this online survey. The level of disability caused by LBP was evaluated using the Revised Oswestry Low Back Pain Disability Questionnaire (Hudson-Cook et al., 1989). While for the Malay version, this study used

the translated Revised Oswestry Disability Questionnaire by Zarina et al. (2019). This questionnaire is a self-reported tool that measures LBP patients' ability to handle their activity daily living that is affected, caused by the condition (Zarina et al., 2019).

3.3 Data Analysis

Data analysis was performed using SPSS version 26.0. Descriptive statistics analysis was calculated using frequencies and percentages to determine the prevalence of LBP among T2DM. As all of the data were categorical variables, inferential statistics were performed using the chi-square test and Fisher's Exact test to investigate the association between LBP and sociodemographic characteristics, as well as clinical data of T2DM. The severity of LBP intensity and disability level was presented in frequencies, percentages, and mean and standard deviation. The level of statistical significance was set at $\alpha<0.05$ and a 95% confidence level.

4.0 Findings

4.1 Sociodemographic Characteristics and Clinical Data

Table 1 showed that approximately two-thirds (67.1%) of the respondents were female, followed by male (32.9%). A third (37.3%) of samples were 50 to 59 years old, and most participants were Malays (94.4%). Over half (62.7%) were workers for employment status, and the rest were not working (37.3%). About three-quarters (72.0%) of the respondents' education status were University or College graduates, and 39.8% of the participants were obese (BMI over 30 kg/m2). As for diabetes duration, over one-half (54.7%) of the respondents had become diabetes sufferers for more than five years. Almost half (44.7%) of the respondents consume oral medicine with insulin**.**

Table 1. Sociodemographic characteristics and clinical data among T2DM in Klang Valley, N=161

Characteristic	N (%)
Gender	
Male	53 (32.9)
Female	108 (67.1)
Age (years)	
20-29	12 (7.5)
30-39	35 (21.7)
40-49	36 (22.4)
50-59	60 (37.3)
≥60	18 (11.2)
Race	
Malay	152 (94.4)
Chinese	2 (1.2)
Indian	2 (1.2)
Others	5 (3.1)
Employment status	
Working	101 (62.7)
Not working	60 (37.3)
Education level	
No formal education	2 (1.2)
Primary School	5 (3.1)
High School	38 (23.6)
University or College	116 (72.0)
Body mass index (kg/m2)	
<18.5	1 (0.6)
18.5-24.9	43 (26.7)
25.0-29.9	53 (32.9)
≥30	64 (39.8)
Diabetes duration	
Below 5 years	73 (45.3)
Above 5 years	88 (54.7)
HbA1c (%)	
4.5-5.6	22 (13.7)
5.7-6.4	43 (26.7)
6.5-7.0	35 (21.7)
7.1-8.0	31 (19.3)
8.1-9.0	30 (18.6)
FPG (mmol/l)	
≤5.4	21 (13.0)
5.5-6.9	87 (54.0)
≥7.0	53 (32.9)
Antidiabetic medication	
None	24 (14.9)
Oral	27 (16.8)
Insulin	6 (3.7)
Oral and insulin	71 (44.7)
Not remember	33 (20.5)

4.2 Prevalence of Low Back Pain Reported

Over half (55.3%) suffered LBP in the last 12 months, while 35.4% claimed that they were experiencing back pain in the previous seven days (Table 2). Subsequently, nearly two-thirds (64.0%) of the samples that experienced LBP in the previous 12 months also had LBP in the last seven days (Figure 1).

Table 2. Prevalence of low back pain reported among T2DM in Klang Valley, N=161

SNQ-question	Response	Respondents	
		N	%
Low back pain in the last 12 months	yes	89	55.3
	no	72	44.7
Low back pain in last seven days	yes	57	35.4
	no	104	64.6

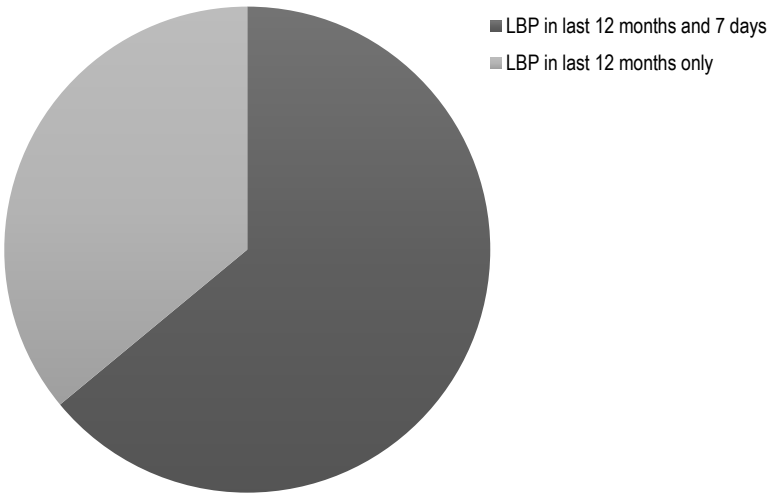

Figure 1. The proportion of respondents that experienced low back pain

4.3 Association between Sociodemographic and Clinical Variables with Reported Low Back Pain

It was found that employment status (X^2=4.088, p=0.043) and education level (X^2=8.572, p=0.018) were significantly associated with LBP among type 2 diabetes patients. Those working and with education status of University or College were more likely to be affected by LBP. Also, reported LBP was associated with FPG level (X^2=6.381, p=0.041), and diabetics with FPG results of more than 7.0 mmol/l appeared to be more affected by LBP.

Table 3. Association between sociodemographic and clinical variables with the reported low back pain among T2DM in Klang Valley, N=161

	12 months prevalence		X^2	p-value
	Yes N (%)	No N (%)		
Gender				
Male	28 (52.8)	25 (47.2)	0.192[a]	0.661
Female	61 (56.5)	47 (43.5)		
Age (years)				
20-29	7 (58.3)	5 (41.7)	2.053[a]	0.726
30-39	22 (62.9)	13 (37.1)		
40-49	17 (47.2)	19 (52.8)		
50-59	34 (56.7)	26 (43.3)		
≥60	9 (50.0)	9 (50.0)		
Race				
Malay	83 (54.6)	69 (45.4)	4.437[b]	0.158
Chinese	0 (0.0)	2 (100.0)		
Indian	2 (100.0)	0 (0.0)		
Others	4 (80.0)	1 (20.0)		
Employment status				
Working	62 (61.4)	39 (38.6)	4.088[a]	0.043
Not working	27 (45.0)	33 (55.0)		
Education level				
No formal education	1 (50.0)	1 (50.0)	8.572[b]	0.018
Primary School	1 (20.0)	4 (80.0)		
High School	15 (39.5)	23 (60.5)		

University or College	72 (62.1)	44 (37.9)		
Body mass index (kg/m2)				
<18.5	1 (100.0)	0 (0.0)	3.227[b]	0.335
18.5-24.9	21 (43.8)	22 (51.2)		
25.0-29.9	27 (50.9)	26 (49.1)		
≥30	40 (62.5)	24 (37.5)		
Diabetes duration				
Below 5 years	44 (60.3)	29 (39.7)	1.348[a]	0.246
Above 5 years	45 (51.1)	43 (48.9)		
HbA1c (%)				
4.5-5.6	10 (45.5)	12 (54.5)	2.781[a]	0.595
5.7-6.4	21 (48.8)	22 (51.2)		
6.5-7.0	21 (60.0)	14 (40.0)		
7.1-8.0	18 (58.1)	13 (41.9)		
8.1-9.0	19 (63.3)	11 (36.7)		
FPG (mmol/l)				
≤5.4	8 (38.1)	13 (61.9)	6.381[a]	0.041
5.5-6.9	45 (51.7)	42 (38.9)		
≥7.0	36 (67.9)	17 (32.1)		
Medicine				
None	12 (44.4)	15 (55.6)	3.757[a]	0.440
Oral	44 (62.0)	27 (38.0)		
Insulin	11 (45.8)	13 (54.2)		
Oral and insulin	18 (54.5)	15 (45.5)		
Not remember	4 (66.7)	2 (33.3)		

[a]Chi-square test, [b]Fisher-exact test

4.4 Severity of Pain Intensity and Disability Level among Type 2 Diabetes Mellitus Patients

Table 4 shows that around a third (36.8%) of the diabetic respondents claimed that their pain due to LBP was at the level of 4, which hurts a little more, while 31.6% stated that their pain level hurts even more (6). This was followed by LBP level 2, which is hurting a little bit (19.3%), level 8; which hurts a whole lot (8.8%) and hurts worst, which at pain level 10 (3.5%), respectively.

Table 4. Pain intensity severity of low back pain among T2DM in Klang Valley, N=161

Characteristics	N (%)
No hurt (0)	0 (0.0%)
Hurts little bit (2)	11 (19.3)
Hurts little more (4)	21 (36.8)
Hurts even more (6)	18 (31.6)
Hurts whole lot (8)	5 (8.8)
Hurts worst (10)	2 (3.5)

Table 5 presents the severity of LBP-related, and nearly half (47.4%) of the type 2 diabetes population that suffer from LBP had a moderate disability with a mean score of 28.07 ± 5.70. Almost a third (31.6%) had a mild disability with a mean score of 14.78 ± 4.29, whereas 14.0% of people with diabetes presented severe disability due to LBP with a mean score of 49.50 ± 6.57. The least (7.0%) level of disability experienced was crippled (mean = 66.50 ± 6.61).

Table 5. Disability severity of low back pain among T2DM in Klang Valley, N=161

N (%)	Mean ± SD	Severity of disability
18 (31.6)	14.78 ± 4.29	Minimal disability
27 (47.4)	28.07 ± 5.70	Moderate disability
8 (14.0)	49.50 ± 6.57	Severe disability
4 (7.0)	66.50 ± 6.61	Crippled

5.0 Discussion

This study found that 12 months prevalence of LBP among T2DM participants was 55.3%. This is in line with the majority of LBP observed in other countries such as Nigeria (46.2%) and Iran (63.4%), which were studied by Idowu et al. (2015) and Eivazi et al. (2012), respectively. Most studies that compared the prevalence of LBP among diabetes with non-diabetes reveal that LBP is more frequent among diabetics. Florencio et al. (2020) found that diabetes individuals have a higher prevalence of LBP (34.8%) than individuals without diabetes (29.0%), similarly to a study by Jimenez-Garcia et al. (2018) that reported that LBP among people with diabetes is more prevalent compared for those without it (37.0% vs 30.3%). These findings agree with the evidence that LBP is common in diabetes patients.

It was also revealed that about 64.0% of T2DM patients who suffered back pain in the preceding 12 months also claimed that they had LBP in the last seven days. This indicates how regularly the pain disturbs them. Although there are no direct links between these two conditions, T2DM is thought to contribute to LBP through some mechanisms (Rinaldo et al., 2017). T2DM could hasten stress-induced senescence in the intervertebral disc, leading to early degeneration of the disc. It was more than those without diabetes (Sudhir et al.,

2020). Besides a chronic hyperglycemia environment has a negative effect on chondrocytes metabolism within the extracellular matrix of articular cartilage as it could contribute to pro-inflammatory and pro-degradative impact (Veronese et al., 2019).

Significance association was found between FPG and LBP, similar to a study by Idowu et al. (2015), reporting that people with diabetes with higher FPG levels were more prone to experiencing LBP. Nevertheless, this study found no association between HbA1c status and LBP, although FPG and HbA1c are a test to determine glycemic control in diabetics. Conforming to Real et al. (2017), a higher HbA1c level did not significantly increase the likelihood of reporting LBP. However, it did statistically increase the odds of having LBP only in diabetes patients with normal weight. Rinaldo et al. (2017) mentioned that unrestrained hyperglycemia might influence back pain development. AGEs increase a high glucose concentration in cells and tissues, causing pro-inflammatory and pro-degradative effects that could promote spinal degeneration (Veronese et al., 2019; Real et al., 2017).

However, antidiabetic medication was found to have no association with LBP correspondingly to a study by Hassoon et al. (2017), which observed no significant difference in diabetes management with the LBP experience. Even though it was believed that DPP-4 inhibitors, which is a class of antidiabetic drugs, are associated with joint pain, there is evidence stating that people are consuming metformin, another diabetes medication, were lesser to report musculoskeletal pain, including at the back site compared to people that do not consume it (Rai et al., 2019; Carvalho-e-Silva et al., 2021). Metformin could reduce inflammation, counteract oxidative stress and regulate mitochondrial autophagy that could protect chondrocytes from injury (Song et al., 2022). Hence, the role of anti-diabetes medications as an associated factor of LBP remains to be determined.

Data from the present study showed that the association between sociodemographic characteristics and LBP was employment status and education level. This study revealed that people with diabetes who are working and have higher education levels were more likely to experience back pain. Eivazi et al. (2012) also found a significant association between job status and LBP occurrence. Despite that, the association between educational levels was found in a study by Jimenez-Garcia et al. (2018). However, they reported that lower education diabetes patients were more prevalent in having LBP. The results could be due to regional differences, as more T2DM patients participating in this study have higher educational levels than in the Spain study.

Furthermore, the severity of pain intensity and disability due to LBP were evaluated to understand the type 2 diabetics' experience and its impact on their daily activities. Their pain was claimed to be moderate, with a score of 4 and 6. These are consistent with the study by Eivazi et al. (2012), which also reported the same pain intensity with about 4 and 6 levels. Nonetheless, T2DM patients reported mild to moderate levels of disability due to LBP in this study. Idowu et al. (2015) compared the disability level of non-diabetics and found that T2DM patients have higher disability levels. This may be due to medical management, strict dietary advice and handling negative emotions, including fear and depression, that could further affect the patient's level of disability (Idowu et al., 2015).

6.0 Conclusion & Recommendations

In summary, the current study found that the prevalence of LBP was high among people living with type 2 diabetes. It was found that those LBP were presented with moderate pain intensity and mild to moderate levels of disability. Employment status, educational level and clinical characteristics of FPG level were found to be associated with LBP in T2DM patients. Even though this study is only questionnaire-based, it adds to the knowledge about these two conditions, particularly in Malaysia. Physiotherapists need to be aware and give adequate attention to this type of problem with appropriate prevention and management strategies as the burden of having LBP complications with other diabetes-related complications at a time could contribute to the patient's disability, thus affecting their quality of life. Therefore, studies more in-depth regarding the links between LBP and T2DM should be conducted in the future.

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Paper Contribution to Related Field of Study

The high prevalence of LBP among T2DM indicates it is critical to pay enough attention to this issue with other diabetes complications. Pain impairs one's health and quality of life. Hence, it is vital to preserving health quality in diabetic patients by managing hyperglycemia and other factors contributing to LBP (Shahid et al., 2020). Better awareness of potential associated factors can aid in the development of management strategies by health care practitioners, thus decreasing the impact of this type of problem among T2DM patients (Florencio et al., 2020).

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