FACTORS ASSOCIATED WITH UNDIAGNOSED DIABETES MELLITUS AMONG THE PEKA B40 POPULATION ON LANGKAWI ISLAND FROM 2022 TO 2023

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by

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LIST OF SYMBOLS

*	Asterisk
<	Less than
>	More than
≥	Greater than or equal to
μ	Mean
B	Beta (regression coefficient)
d	Detectable difference relative precision
m	The ratio of independent variable
p	p-value
n	Sample size
α	Alpha (significance level)
~	Approximate
%	Percentage
Zα	The Z - score associated with the level of significance
P	Proportion

LIST OF ABBREVIATIONS

Adj. OR	Adjusted Odds Ratio
BMI	Body Mass Index
CI	Confidence interval
CPG	Clinical Practice Guideline
DM	Diabetes Mellitus
DOSM	Department of Statistics Malaysia
EHR	Electronic health records
FINDRISC	Finnish Diabetes Risk Score
HREC	Human Research and Ethics Committee
IDF	International Diabetes Federation
IL	Interleukin
IPH	Institute for Public Health
KOSPEN	Komuniti Sihat Perkasa Negara
LMICs	Low- and middle-income countries
LDL	Low-Density Lipoprotein
LR	Likelihood Ratio
MET	Metabolic equivalent of task
MREC	Medical Research and Ethics Committee
MOH	Ministry of Health
MVPA	Moderate-to-vigorous physical activity
NCDs	Non-communicable diseases
NHMS	National Health and Morbidity Survey
OR	Odds Ratio

PeKa B40	Skim Peduli Kesihatan untuk Kumpulan B40
QOL	Quality of life
ROC	Receiver Operating Characteristic
SES	Socio-economic status
SPSS	Statistical Package for Social Sciences
TNF	Tumor necrosis factor
TyG	Triglyceride glucose index
WHO	World Health Organization

LIST OF APPENDICES

FAKTOR-FAKTOR YANG BERKAITAN DENGAN DIABETES MELLITUS YANG TIDAK DIDIAGNOSIS DALAM KALANGAN POPULASI PEKA B40 DI PULAU LANGKAWI DARI TAHUN 2022 HINGGA 2023

ABSTRAK

Pengenalan: Prevalens diabetes yang tidak didiagnosis merupakan satu cabaran kesihatan awam yang ketara, terutamanya di kalangan populasi yang kurang bernasib baik dari segi sosio-ekonomi. Kajian ini bertujuan untuk menilai prevalens dan faktor-faktor yang berkaitan dengan diabetes yang tidak didiagnosis dalam kalangan populasi PeKa B40 di Pulau Langkawi, Malaysia.

Metodologi: Satu kajian keratan rentas retrospektif telah dijalankan menggunakan rekod data sekunder dari Januari 2022 hingga Disember 2023, melibatkan 1,070 peserta daripada populasi PeKa B40 di Pulau Langkawi. Peserta-peserta ini telah disaring sebelum ini untuk diabetes menggunakan ujian glukosa darah berpuasa dan tahap HbA1c sebagai sebahagian daripada inisiatif PeKa B40. Data sosiodemografi, status kesihatan semasa, faktor gaya hidup, sejarah keluarga, dan sejarah perubatan telah diekstrak daripada rekod PeKa B40 yang sedia ada. Statistik deskriptif digunakan untuk meringkaskan data, dan analisis regresi logistik berganda dijalankan untuk mengenal pasti faktor-faktor yang berkaitan dengan diabetes yang tidak didiagnosis**.**

Keputusan: Prevalens DM yang tidak didiagnosis didapati sebanyak 6.7% dalam populasi kajian. Faktor-faktor utama yang berkaitan dengan DM yang tidak didiagnosis termasuk sejarah perubatan, BMI yang lebih tinggi, dan tinggal di pulau-pulau kecil. Peserta yang diklasifikasikan sebagai berat badan berlebihan dan obes didapati lebih berkemungkinan untuk mempunyai DM yang tidak didiagnosis

berbanding dengan mereka yang mempunyai BMI normal (Adj. OR: 2.72, 95% CI: 1.40,5.30, p=0.003) untuk berat badan berlebihan; (Adj. OR: 2.43, 95% CI: 1.19,5.00, p=0.015) untuk obes. Individu yang tinggal di pulau-pulau kecil mempunyai kebarangkalian yang lebih tinggi untuk DM yang tidak didiagnosis berbanding dengan mereka yang tinggal di pulau utama (Adj. OR: 1.71, 95% CI: 1.03,2.85, p=0.039). Peserta dengan sejarah perubatan yang didokumentasikan didapati kurang berkemungkinan untuk mempunyai DM yang tidak didiagnosis (Adj. OR: 0.21, 95% CI: 0.12,0.36, p<0.001).

Kesimpulan: Prevalens DM yang tidak didiagnosis yang tinggi dalam kalangan populasi PeKa B40 menekankan keperluan mendesak untuk mempertingkatkan program saringan dan pengesanan awal. Strategi kesihatan awam harus memberi tumpuan kepada kempen pendidikan yang disasarkan, memperluaskan infrastruktur penjagaan kesihatan, dan mengintegrasikan saringan oportunistik dalam interaksi penjagaan kesihatan rutin untuk memperbaiki pengesanan awal dan pengurusan DM.

Kata kunci: DM yang tidak didiagnosis, PeKa B40, Pulau Langkawi, BMI, kesihatan awam, program saringan

FACTORS ASSOCIATED WITH UNDIAGNOSED DIABETES MELLITUS AMONG THE PEKA B40 POPULATION ON LANGKAWI ISLAND FROM 2022 TO 2023

ABSTRACT

***Introduction*:** The prevalence of undiagnosed DM poses a significant public health challenge, particularly among socio-economically disadvantaged populations. This study aims to evaluate the prevalence and factors associated with undiagnosed DM among the PeKa B40 population on Langkawi Island, Malaysia.

***Methodology*:** A retrospective cross-sectional study was conducted using secondary data records from January 2022 to December 2023, involving 1,070 participants from the PeKa B40 population on Langkawi Island. Participants were previously screened for DM using fasting blood glucose tests and HbA1c levels as part of the PeKa B40 initiative. Sociodemographic data, current health status, lifestyle factors, family history, and medical history were extracted from the existing Peka B40 records. Descriptive statistics were used to summarize the data, and multiple logistic regression analyses were performed to identify factors associated with undiagnosed DM.

***Results*:** The prevalence of undiagnosed DM was found to be 6.7% among the study population. Key factors associated with undiagnosed DM included medical history, higher BMI, and residing on smaller islands. Participants classified as overweight and obese were significantly more likely to have undiagnosed DM compared to those with a normal BMI (Adj. OR: 2.72, 95% CI: 1.40,5.30, p=0.003) for overweight; (Adj. OR: 2.43, 95% CI: 1.19,5.00, p=0.015) for obese. Individuals residing on smaller islands

had a higher likelihood of undiagnosed DM compared to those on the main island (Adj. OR: 1.71, 95% CI: 1.03,2.85, p=0.039). Participants with a documented medical history were significantly less likely to have undiagnosed DM (Adj. OR: 0.21, 95% CI: 0.12,0.36, p<0.001).

***Conclusion*:** The high prevalence of undiagnosed DM among the PeKa B40 population underscores the urgent need for enhanced screening and early detection programs. Public health strategies should focus on targeted education campaigns, expanding healthcare infrastructure, and integrating opportunistic screening into routine healthcare interactions to improve early detection and management of DM.

***Keywords*:** Undiagnosed DM, PeKa B40, Langkawi Island, BMI, public health, screening programs

CHAPTER 1

INTRODUCTION

1.1 Background of the study

1.1.1 Diabetes Mellitus

Diabetes Mellitus (DM) constitutes a significant worldwide public health issue, influenced by a range of factors including the aging population, urbanization, and a rising prevalence of overweight and obesity (IDF, 2021). DM, more simply called diabetes, is a serious, long-term (or "chronic") condition that occurs when raised levels of blood glucose occur because the body cannot produce any or enough of the hormone insulin or cannot effectively use the insulin it produces. DM is a major global public health concern that is affected by various reasons such as the increasing number of elderly individuals, urbanization, and a growing incidence of overweight and obesity (Dianna J Magliano *et al.*, 2021). According to the World Health Organization (WHO), about 422 million people worldwide have diabetes, the majority living in low- and middle-income countries, and 1.5 million deaths are directly attributed to diabetes each year (WHO, 2016). The International Diabetes Federation (IDF) projects that by 2045, about 783 million adults, or 1 in 8, will be afflicted with diabetes worldwide (Sun *et al.*, 2022).

Based on the findings of the National Health and Morbidity Survey (NHMS) 2019, almost 20% of adult Malaysians are affected by diabetes. The survey revealed a surge in the prevalence of diabetes in Malaysia between 2011 and 2019, with diagnosed cases escalating from 13.4% to 18.3% (IPH, 2020). Interestingly the NHMS

2023 revealed that prevalence overall diabetes is 15.6% indicating reduction from the previous survey in 2019 (IPH, 2024).

1.1.2 Undiagnosed Diabetes Mellitus

Globally, 87.5% of all undiagnosed cases of diabetes are in low and middle-income countries, with low-income countries having the highest proportion undiagnosed (50.5%). However, even in high-income countries, almost a third (28.8%) of people with diabetes have not been diagnosed (Sun *et al.*, 2022). In 2021, almost one-in-two (44.7%; 239.7 million) adults living with diabetes (20–79 years old) were found to be unaware of their status (Ogurtsova *et al.*, 2022). According to Manne-Goehler *et al.* (2019) which included over 800,000 adults in a pooled cross-sectional analysis from 28 low- and middle-income countries, the overall prevalence of diabetes was 8.8 of which 4.8% was undiagnosed.

Undiagnosed diabetes and impaired glucose regulation are reported to have substantial clinical importance and public health implications because these individuals remain untreated, and they are at risk of serious complications. Prior studies have shown that undiagnosed DM, compared to diagnosed DM, was linked to significantly higher cardiovascular risk and prone to uncontrolled hypertension and elevated Low-Density Lipoprotein (LDL) (Lee *et al.*, 2015). Study done by Palladino *et al.* (2020) mentioned that microvascular and macrovascular diseases are detected in 37%–24% of people with newly diagnosed type 2 diabetes. Pre- diabetes or before diagnosis of type 2 diabetes is associated with increased odds of microvascular disease and acute coronary syndrome. It is fundamental for people with diabetes to be diagnosed as early as possible to prevent or delay complications, avoid a premature

death, and improve quality of life. A serious concern is that people with diabetes diagnosed later, rather than earlier, are likely to use more healthcare services due to greater likelihood of diabetes complications, placing an added burden on healthcare systems already under pressure.

Whereas in Malaysia, the National Health Morbidity Survey (NHMS) done on 2019 showed that the prevalence of raised blood glucose amongst those not known to have diabetes was 8.9% (IPH, 2020). These findings were slightly reduce from the NHMS 2015 which the prevalence of undiagnosed DM is 9.2% (IPH, 2015). Latest findings from the survey on 2023 revealed that prevalence of undiagnosed DM was 5.9% (IPH, 2024).

1.1.3 Skim Peduli Kesihatan untuk Kumpulan B40 (PeKa B40)

One programme that the Malaysian government has put in place to help low-income groups with their healthcare needs is the Skim Peduli Kesihatan for the B40 group (PeKa B40). This programme aims to reduce the prevalence of non-communicable diseases (NCDs) and provide assistance to those in need. Launched on September 27, 2021, the 12th Malaysia Plan placed emphasis on non-communicable diseases (NCDs) in its second topic and fourth chapter. It outlined the government's dedication to addressing significant health concerns like cancer, DM, and mental health during the following five years (Razif *et al.*, 2021).

The primary goal of PeKa B40 is to serve as a financial safeguard, ensuring fair and equitable access to healthcare services for the B40 population. Since its inception, PeKa B40 has identified a significant number of undetected non-communicable diseases (NCDs) among a large percentage of the population. Thus, PeKa B40 program

has detected at least one non-communicable disease (NCD) in 151,729 people, representing 33% of the 457,462 participants who completed health tests. The diagnoses encompass diabetes (10.4%), hyperlipidemia (29.8%), hypertension (13.8%), major depressive disorder (1.6%), and generalised anxiety disorder (1.4%). The PeKa B40 health screenings were conducted at government health clinics across Malaysia, including Langkawi Island. These screenings involved comprehensive health assessments such as fasting blood glucose tests, HbA1c measurements, and blood pressure checks, performed by trained professionals. Participants with abnormal results received follow-up consultations and referrals to ensure proper medical care and lifestyle guidance. This program has significantly enhanced health screening rates among low-income demographics in Malaysia. As of December 31, 2021, the program had examined a total of 555,311 recipients. Among those screened, females accounted for 58.4% and were mainly between the ages of 60 and 69 (Razif *et al.*, 2021).

Despite these improvements, however, the utilization of PeKa B40 is still not optimal. By May 31, 2022, the utilization rate of the free health screenings provided by the initiative was just 10.5% among eligible individuals. However, Kedah had a slightly higher rate of 17% (Razif *et al.*, 2021). The Langkawi District Health Office emphasizes the issue by revealing that as of September 30, 2023, out of a total of 19,960 eligible individuals, only 1,622 individuals used themselves for health screening, which accounts for less than 1% utilization. Yunus *et al.* (2021) found low usage rates of 7.6% in their Klang Valley study. This suggests a broader trend of underutilization of government efforts throughout the targeted group.

1.2 Problem Statement

Health screening is more common and generally embraced approach in the healthcare system. Its main goal is to discover diseases at an early stage and offer individuals the chance to make changes to their unhealthy habits through early intervention. Early health screening is particularly useful for detecting chronic illnesses in their early stages, often before symptoms become apparent. Early detection enables prompt treatment, potentially averting problems and greatly enhancing a patient's quality of life (QOL). Although there are advantages, socioeconomic issues present significant obstacles to the PeKa B40 group's involvement in health screening. The B40 demographic, which comprises the lowest 40% of income earners in Malaysia, faces unique challenges when it comes to obtaining healthcare services, such as medical check-up and health screening.

Research from multiple countries has demonstrated that the socio-economic condition of a population influences the frequency of health screenings for chronic illnesses like cancer and diabetes. In Malaysia, there are still lacks significant studies on the obstacles to health screening among the B40 population. The prevalence of undiagnosed diabetes mellitus (DM) presents a significant public health concern, particularly within the B40 socio-economic group in Malaysia. Early detection through health screening is crucial for preventing complications associated with DM, such as cardiovascular disease, neuropathy, and retinopathy. However, there is limited information regarding the factors contributing to undiagnosed DM among the B40 population, especially in geographically isolated areas like Langkawi Island.

Based on the IPH (2015) findings, 47.6% of adults aged 40 and above in the B40 group experience at least one non-communicable disease (NCD), which may include undiagnosed DM. Undiagnosed diabetes presents substantial dangers, resulting in problems such as cardiovascular illnesses, neuropathy, and retinopathy, which can greatly reduce the quality of life and raise healthcare expenses.

There is a notable gap in the literature regarding the prevalence and factors associated with undiagnosed DM among low socio-economic populations, particularly in island communities such as Langkawi. Understanding the burden of undiagnosed diabetes in these populations is critical for a variety of reasons.

Firstly, island communities often face unique healthcare challenges due to geographical isolation, limited healthcare infrastructure, and reduced access to medical services. People live in small island which geographically isolated area particularly, exemplifies these challenges. The limited availability of healthcare facilities and professionals on the island can result in delayed diagnoses and inadequate management of chronic diseases, including diabetes. These factors can exacerbate the difficulties faced by economically disadvantaged individuals in obtaining timely and adequate health screenings.

Secondly, the socio-economic profile of the B40 population on Langkawi Island, which comprises the bottom 40% of income earners in Malaysia, adds another layer of complexity. This group is particularly vulnerable to health disparities due to their lower income levels for example working as fisherman, which can limit their access to healthcare services, health education, and preventive measures. Low socio-economic status is a significant risk factor for undiagnosed DM, and an isolated island setting likely amplifies this risk, as previous studies have shown.

Thirdly, Langkawi's population includes a significant proportion of residents who engage in tourism-related occupations, which often involve irregular working hours, physical strain, and limited opportunities for regular health check-ups. These occupational factors can contribute to the risk of undiagnosed DM, as individuals may prioritise their immediate economic needs over long-term health considerations.

1.3 Rationale of study

The objective of this study is to examine the factors linked to undiagnosed DM among the PeKa B40 population residing on Langkawi Island. The research will provide healthcare officials with valuable insights by identifying these elements that can aid in the development and implementation of focused primary care services. The primary objective of these services is to enhance the early identification and treatment of diabetes, thereby decreasing the impact of associated problems and improving the overall well-being of individuals from low socio-economic backgrounds.

By focusing on Langkawi, this study aims to provide a representative assessment of the burden of undiagnosed DM among low socio-economic islander populations, offering insights that are relevant not only to Langkawi but also to similar communities across Malaysia. The findings can serve as a foundation for developing targeted interventions and policies aimed at improving primary care services for economically disadvantaged groups. Policymakers and healthcare practitioners can utilise this data to design and implement programmes that address the specific needs and barriers faced by the B40 population on Langkawi. These programmes might include community-based screening initiatives, educational campaigns about diabetes prevention and management, and enhanced access to affordable healthcare services.

In conclusion, this study has the potential to significantly improve the efficiency of healthcare services on Langkawi by reducing the number of undiagnosed cases of DM. By identifying the factors that contribute to undiagnosed diabetes, this research can lead to better health outcomes for the population, ultimately contributing to the overall goal of reducing health disparities and improving the quality of life for low socio-economic communities.

1.4 Research Questions

1. What is the prevalence of undiagnosed DM among PeKa B40 population on Langkawi?
2. What are the associated factors of undiagnosed DM among PeKa B40 population on Langkawi?

1.5 Research Objectives

1.5.1 General Objective

To describe the status of undiagnosed DM among PeKa B40 population on Langkawi

1.5.2 Specific Objectives

1. To estimate the prevalence of undiagnosed DM among PeKa B40 population on Langkawi Island from 2022 to 2023
2. To determine the associated factors of undiagnosed DM among PeKa B40 population on Langkawi Island from 2022 to 2023