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Association Between Body Mass Index and Health-Related Quality of Life Among High Risk Pre-Diabetes Adults in Kuala Terengganu

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Abstract

People with pre-diabetes has the higher risk of developing diabetes. Type 2 diabetes mellitus (T2DM) decreases health-related quality of life (HRQoL), but there is a lack of information about the HRQoL of adults who are at risk of developing diabetes. Therefore, we aimed to determine the HRQOL and its association with Body Mass Index (BMI) among high risk pre-diabetes adults in Kuala Terengganu. This cross-sectional study was conducted among individuals aged between 18 and 65, living, working or studying in Kuala Terengganu who are at risk of developing diabetes through CDC Pre-Diabetes Risk Test. Data was collected through self-administered questionnaires assessing the demographic characteristics BMI and HRQoL. Data entry and analysis were performed using the SPSS version 20.0. Out of 54 participants, 7.6% were pre-diabetic. The mean BMI in the present study was 29.43 ± 5.34 kg/m^2 with the prevalence of overweight and obese were 63% and 29.5%, respectively. The highest score was physical functioning (82.96 ±15.53) while the lowest score was vitality (62.45 ±10.53). High risk pre-diabetes adults who were obese had significantly lower scores of mental health of SF-36 than those with overweight (62.00 vs 71.27; $p< 0.05$). The result showed that there were no significant associations between BMI and physical component score ($p= 0.312$) and mental component score ($p=0.057$) of HRQoL. The negative effects of obesity on HRQoL indicate that it is important to monitor weight to promote HRQoL in high risk diabetes adults.

Keywords: Keywords: Body mass index (BMI), Health-related quality of life (HRQoL), Mental component score (MCS), Physical component score (PCS)
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Introduction

Uncontrolled level of sugar intake could lead to pre-diabetes and develop a high risk of diabetes mellitus type 2 (T2DM); pre-diabetes is the elevated level of blood glucose but not to exceeding which can be categorized as diabetes (Whitney & Rolfes, 2013). It can be referred to the patient that have Impaired Fasting Glucose (IFG) or Impaired Glucose Tolerance (IGT) (Ibrahim et al., 2014). Based on another study found that age is one of a factor that can encourage the high occurrence of pre-diabetes (Xu et al., 2018). According to National Health and Morbidity Survey (NHMS) report (2011), the prevalence of T2DM was increased from 14.9% in 2006 to 20.8% in 2011 which affecting 2.8 million people (NHMS, 2011). In 10 years, the prevalence of diabetes in Malaysia had increased to 17.5% from 2006 to 2015. Mustafa, Kamarudin & Ismail (2011) study reported that prevalence in pre-diabetes in Malaysia among adult was 22.1% that affect almost half of the adults aged between 30 and 49 years. Meanwhile, the prevalence for a patient that with IFG was lower (3.4%) compared with IGT (16.1%). It is predicted, the diabetic population in Malaysia will continue to rise to 4.5 million (21.6%) by the year 2020 (Ibrahim, et al., 2016). According to the National Health and Morbidity Survey (NHMS) report (2015), the prevalence of diabetes in Terengganu was increased from 11.6% in 2011 to 18.6% in 2015.

Even if a patient with pre-diabetes experience no symptom and usually not having knowledge about their own condition, around 10-20% of them had mild micro and macrovascular complication which can disturb the impact of health-related quality of life (Makrilakis et al., 2018). There is a lack study on the relationship between weight status and quality of life among pre-diabetes; it has been shown that obese or overweight people with presence of diabetes were significantly associated with impaired of health-related quality of life (HRQoL) (Ibrahim, et al., 2014; Eddolls et al., 2018). This HRQoL can measure population health, life expectancy, the impact of health status, and course of death. Since, the prevalence of pre-diabetes, IFG, IGT, and obesity or overweight rises so quickly from year to year, thus the result obtained from this study can be used in improving the HRQoL and intervention to develop T2DM.

So far, there is no study had been carried out about the association between BMI and HRQoL among pre-diabetes adults in a population of Kuala Terengganu. In this study, we want to discover the relationship of BMI with HRQoL among high risk of pre-diabetes adults. When those issues related to body weight status is not managed carefully were triggered the people who had pre-diabetes to develop another comorbidities factor such as T2DM, cardiovascular disease, and other non-

communicable diseases. However, this association had been figured out before which stated the pre-diabetes person who was obese or overweight had lower HRQoL compared to the person that normal weight (Ibrahim et al., 2014). Therefore, the aim of these studies to determine the association between body mass index (BMI) and HRQoL among the high risk pre-diabetes adults in Kuala Terengganu.

Methodology

This study was a cross-sectional study that carried out in September 2018 until May 2019 in Kuala Terengganu. In this study, the variables are not manipulated, and the information provided is current occurrence on population. The sampling method used in this study was convenience sampling. It is a specific type of non-probability sampling method that relies on data collected from a participant who is willingly available to participate in this study if they met the inclusion criteria given.

A total of 223 participants from Kuala Terengganu were screened for eligibility to participate in the study. After screening for eligibility, 152 were excluded due to scored equal or more than nine of CDC Pre-Diabetes Screening Test (n=150) and pregnant (n= 2). Finally, a total of 71 eligible participants aged between 18 and 65, living, working or studying in Kuala Terengganu, Terengganu, with BMI >18.5 kg/m^2 and high risk for diabetes (CDC Pre-Diabetes Risk Test score ≥9 (CDC., 2019) or HbA1c of 38-44 mmol/mol or 5.6-6.2% (Clinical Practice Guideline, 2016) were invited to participate. Meanwhile, participants with clinical history or diagnosed as diabetes, consuming oral antidiabetic agent, diagnosed with chronic disease and pregnant were excluded in the study. Participants who met the study criteria were given information sheet explaining the aim of the study and consent form to participate in this study before the administration of data collection. According to Figure 1, finally 54 participants who gave written consent were recruited in the study.

The data was collected from January to March 2019. The data collection was carried out at Kuala Terengganu area. Socio-demographic data were self-administered by participants including age, gender, ethnicity, marital status, education, occupation, and monthly house income. The patients have also been asked about any absent or present of comorbidities conditions such as the history of diabetes in the family, hypertension, dyslipidemia, and smoking.

The standing height measurement by using portable stadiometer (Seca 213, Germany) must recorded to the nearest 0.1 cm. The patient's measurement of height should be without shoe. The weight of patient also be measured by using portable digital scale (Tanita, Model: BC-587). The recorded reading should be nearest to the 0.1 kg. The procedure needs to be with light clothing and without shoes. The BMI is calculated by divided weight with height in meter squared (kg/m^2). The guideline in BMI for adult by World Health Organization (WHO, 2012), concern person with BMI >30 kg/m^2 is obese while for overweight is 25.0-29.9 kg/m^2. Meanwhile for underweight is <18.5 kg/m^2. The normal and healthy BMI is 18.5-24.9 kg/m^2.

The HRQoL was assessed using a self-administered bilingual version of the SF-36 health survey questionnaire. The SF-36 health survey questionnaire was already translated and validated in Malaysia (Azman, et al., 2003) and the Malay version of SF-36 is reported to be reliable and valid (Sararaks, et al., 2005). It contains 36 items which measure eight health domains which are physical functioning (PF), role-physical (RF), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotion (RE) and mental health (MH). The eight domains were scored from 0 to 100 indicating worst to greatest possible health. All the scores were then summarised into the Physical Component Summary score (PCS) and the Mental Component Summary score (MCS).

The statistical analysis of data was performed using IBM SPSS for Windows version 20.0. The prevalence of pre-diabetes in Kuala Terengganu present with frequency and percentage with 95% CI. The descriptive analysis for the sociodemographic present as mean with standard deviation and frequency (%). Spearman rank correlation coefficient test was used to explore the relationship between the variables that influenced HRQOL.

Ethical approval was obtained from UniSZA Human Research and Ethics Committee (UHREC) prior to the study (UniSZA/UHREC/2018/82). Participants who agreed to take part in the study were required to give written informed consent.

Results

A total of 54 participants whose high risk of pre-diabetes in district Kuala Terengganu, aged from 18 to 65 years old were recruited in this study. The mean (SD) age of all participants was 39.52 (12.90) years old. Most of the participants were female (55.60%) with majority were Malays (92.60%). Based on the educational level, 39 participants (72.20%) widely held tertiary educational level either by completing their diploma, degree, masters, or Ph.D. Most of the participants were single (61.10%). The present study also reported 68.50% of participants were employed and another 31.50% were unemployed. Even though, most participants were employed and had tertiary educational level, most of them (42.70%) had a low monthly income which was < RM 1500 compared to moderate (20.40%) and high (37.00%) monthly income.

The mean height, weight, and BMI participants in the present study were 161.09 (9.51) cm, 77.04 (18.75) kg, 29.43 (5.34) kg/m^2, respectively. When divided into BMI categories, the prevalence of overweight and obese were 63% and 29.5%, respectively (Table 1). Out of 54 participants, the prevalence of pre-diabetes in the present study was 7.6% that stated in Figure 2.

The influence of BMI on HRQOL is presented in Table 2. The lowest mean score was Vitality (VT) [62.45 (10.53)] while the highest mean score was Physical Functioning (PF) [82.96 (15.53)]. High-risk pre-diabetes adults who were obese generally reported lower scores for most of SF-36 scales when compared to high-risk pre-diabetes adults with normal weight, indicating poorer HRQOL. Significant difference was only found in the one of the mental component subscale score; Mental Health. A post-hoc analysis showed significant difference was between the overweight vs obese groups ($p < 0.005$). However, the physical health component subscale scores did not show any significant differences between BMI categories.

Correlations between HRQOL and BMI of adults who are at risk of developing diabetes is presented in Table 3. Spearman's correlation coefficients (r) indicated no significant correlation between Physical Component Summary (PCS) with BMI ($r = -0.140$, $p=0.312$), as well as between Mental Component Summary (MCS) with BMI ($r = -0.261$, $p=0.057$).

Discussion

The prevalence of pre-diabetes in Kuala Terengganu in the present study was doubled (7.6%) compared to National Health Survey and Morbidity (NHMS) in 2015 (3.5%). A recent study conducted in Penang, Malaysia reported a higher prevalence of pre-diabetes compared to the present study which was 10.12% (Rahim et al., 2020). In worldwide, the prevalence of prediabetes among adults has been estimated to be more than 260 million (6.4%) (IDF, 2011). Being obese is one of the factors associated with greater probability of both diabetes and prediabetes (Yach, Stuckler and Brownell KD, 2006). A study conducted by Mustafa and colleagues among 3,879 Malaysian adults, also

reported higher prevalence of prediabetes in the study to be associated with overweight or obesity (Mustafa et al.,2011). In Malaysia, the prevalence of obesity was reported to be 19.7% among adults aged 18 years and above (NHMS, 2019).

Furthermore, individuals diagnosed with prediabetes are at increased risk of having diabetes in the future in which approximately 37% of prediabetes individuals will developed diabetes in four years if they still practiced unhealthy or sedentary lifestyle habits continuously (Knowler et al., 2002). In Malaysia, it is projected that the prevalence of diabetes among adults will rise to 21.6% by 2020 with prevalence of T2DM is 20.8% affecting 2.8 million people (MOH, 2015). Without any interventions among the pre-diabetic patients, it is projected that they have significantly higher risk of developing diabetes in the future. Thus, screening for prediabetes at the earliest stage is very important that would give the opportunity to implement lifestyle interventions to prevent the development of diabetes.

The present study found that the high risk pre-diabetes adults showed lower mental health component score as compared to physical component score. This might imply that among our high risk pre-diabetes adults showed that mental health was affected by their condition. This probably is due to the fact that majority of our high-risk pre-diabetes adults were obese and numerous studies have demonstrated a positive association between obesity and various mental health issues. Obesity impacts individuals' quality of life, with many sufferers experiencing increased stigma and discrimination because of their weight (Sarwer & Polonsky, 2016). On the contrary, another Malaysian population-based study found lower mean scores demonstrated for physical component summary scores of the SF-36 among pre-diabetes individuals as compared to mental component score (Ibrahim et al., 2014).

In the present study, high risk pre-diabetes adults who were obese had significantly lower scores of mental health of SF-36 than those with overweight. Thus, this study affirmed this well recognized finding of previous study that higher BMI was associated with poorer MCS (Daviglus et al., 2003). Similar findings were also found in other studies (Fontaine et al., 2019; Ford et al., 2001; Hassan et al., 2003; Roberts et al., 2000). However, in contrast to some evidence, where obese subjects perceived better mental aspect of HRQOL (Chang et al., 2018). Results from Taiwan suggest that the mental HRQOL of overweight and obese people was at least as good as those of normal weight (Huang, Frangakis and Wu et al., 2006).

Previous research study in Malaysia reported significant correlation with physical aspects of HRQOL among pre-diabetes adults (Ibrahim et al., 2014), which was not observed in the present study. Besides PCS, there was also no significant correlation observed between BMI and MCS in the present study which is similar with previous study among pre-diabetes adults. One of the possible reasons why there was no significant association is due to the measurement of HRQoL which might be less sensitive to the type of impairment in the mental health most likely related to overweight (Ul-Haq et al., 2013). However, a study conducted by Taylor et al. (2014) on HRQoL in individuals with prediabetes had found a negative significant poor correlation of MCS with BMI (-0.18, $p < 0.01$).

Some limitations should be noted. The study was of a cross-sectional design and thus the association that has been demonstrated in the present study may not imply a causal relationship. Importantly, the study was restricted to individuals with high risk of diabetes from Kuala Terengganu, Terengganu. However, a study on pre-diabetes-related QoL has not been reported at the national level, and hence the importance of our study.

Conclusion

This study demonstrates a moderate HRQoL among adults who are at risk of developing pre-diabetes. These findings demonstrated that obese adults who had a high risk of pre-diabetes reported lower scores for most of SF-36 scales compared to those who were normal and overweight indicating poorer HRQOL. The impaired HRQoL is mainly in terms of mental health. The results showed that mental health among the obese group was lowest compared to overweight. The study supports the rationale for developing effective intervention programs for HRQoL of individuals with high risk of developing diabetes.

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Tables and Figures

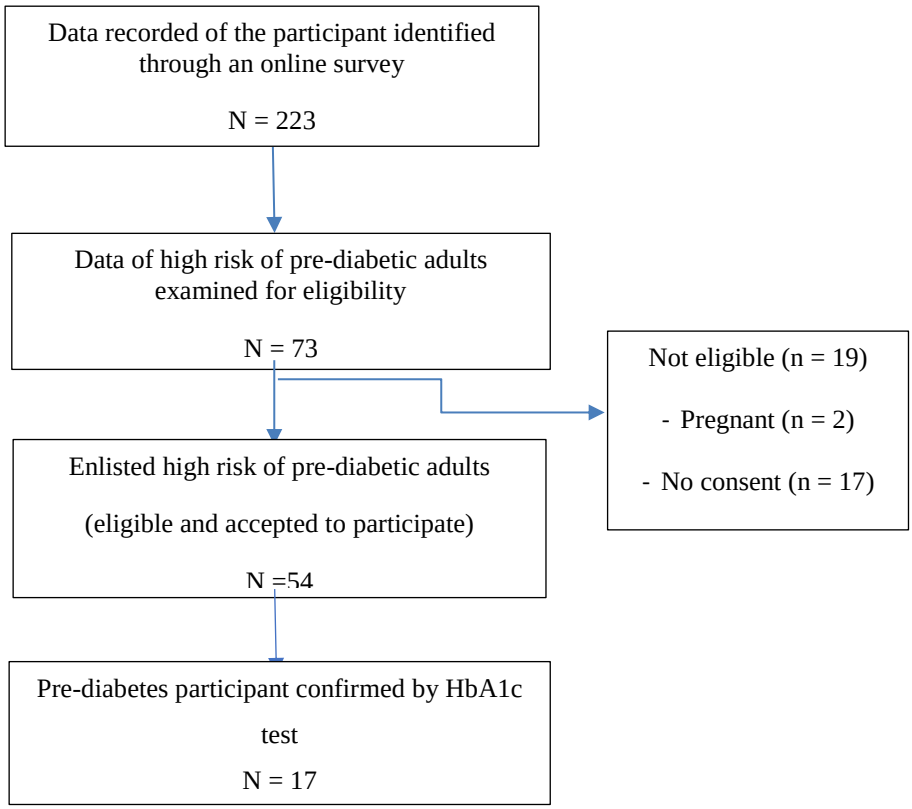

Figure 1: The study flowchart of participants recruitment for pre-diabetes status

Table 1: Characteristics of the high risk of diabetes participants (n=54)

Characteristics	n (%)	Mean (SD)
Age		39.52 (12.60)
Gender		
Male	24 (44.4)	
Female	30 (55.6)	
Ethnicity		
Malays	50 (92.6)	
Indian	1 (1.9)	
Others	3 (5.6)	
Educational level		
Primary	1 (1.9)	
Secondary	14 (25.9)	
Tertiary	39 (72.2)	
Marital status		
Married	20 (37.0)	
Unmarried	33 (61.1)	
Widowed	1 (1.9)	
Employment status		
Employed	37 (68.5)	
Unemployed/retired/homemaker	17 (31.5)	
Monthly income		
Low (< RM 1500)	23 (42.6)	
Moderate (RM 1500-3500)	11 (20.4)	
High (> RM 3500)	20 (37.0)	
Anthropometric measurements		
Weight (kg)		77.04 (18.75)
Height (cm)		161.09 (9.51)
BMI (kg/m^2)		29.43 (5.34)
BMI status		
Underweight	1(1.9)	
Normal weight	3 (5.6)	
Overweight	34 (63.0)	
Obese	16 (29.5)	

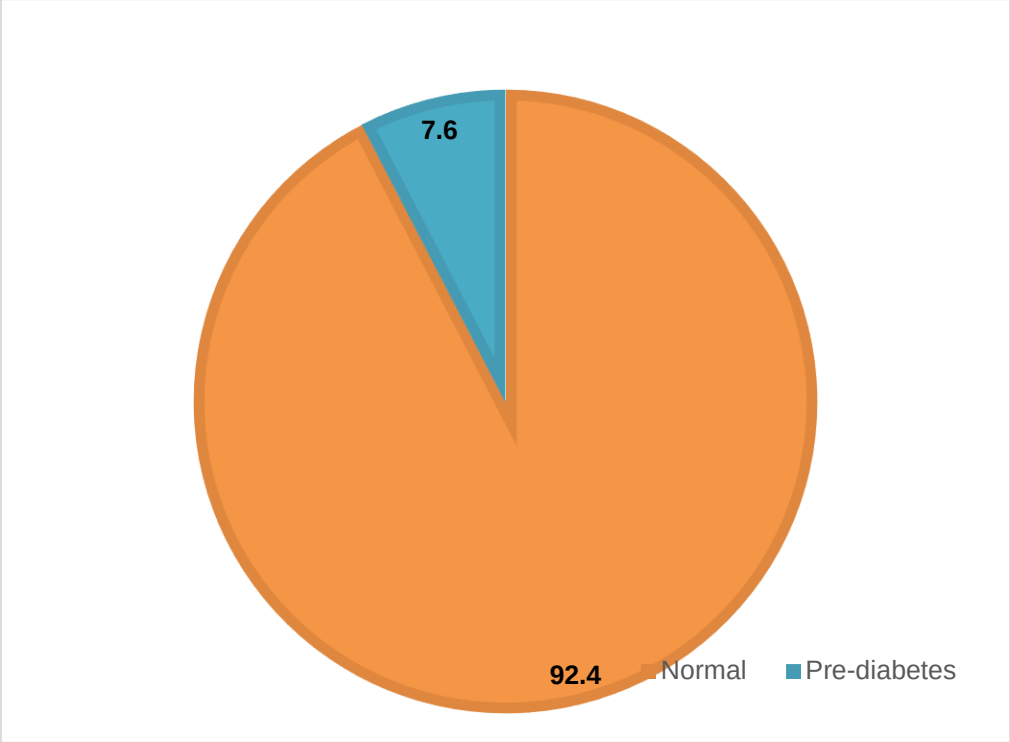

Figure 2: The prevalence of pre-diabetes status

Table 2: Mean scores of SF-36 domains with different BMI categories

SF-36 Domains	Mean (SD)			
	Normal (n = 3)	**Overweight (n=34)**	**Obese (n = 16)**	**p-value**
PCS	80.42 (6.20)	75.03 (15.19)	72.04 (10.52)	0.760
PF	86.67 (7.64)	82.79 (17.42)	82.19 (13.03)	0.940
RP	83.33 (13.01)	75.37 (24.28)	69.14 (25.26)	0.754
GH	62.50 (4.17)	64.83 (16.13)	60.42 (13.78)	0.806
BP	89.17 (18.76)	77.13 (19.45)	76.41 (14.78)	0.728
MCS	75.44 (4.27)	73.17 (11.64)	68.25 (11.51)	0.454
VT	66.67 (5.77)	63.09 (10.87)	59.84 (10.59)	0.564
SF	83.33 (14.43)	80.15 (17.71)	78.91 (19.21)	0.971
RE	94.44 (9.62)	78.19 (22.19)	72.27 (19.76)	0.266
MH	57.33 (16.17)	71.27 (10.41)	62.00 (11.03)	0.020*

Table 3: Association between BMI and HRQoL

SF-36 Domains	**BMI**	
	r	p-value*
PCS	-0.140	0.312
MCS	-0.261	0.057

*Pearson ‘s correlation, p-value