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# The Prevalence of Pre-Diabetes Among Year Two Students in a Malaysian Medical School and Their Knowledge of the Relationship of Obesity with Pre-Diabetes

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## Abstract

**Introduction:** Obesity, a lifestyle disease has been increasing in trend in the recent years. Excess body fat is associated with poor insulin sensitivity and regarded as the single most determinant of type 2 diabetes. Pre-diabetes reigns for a period of almost 13 years prior to the onset of overt diabetes. However, there is a paucity of data on the prevalence of pre-diabetes and the knowledge of relationship between obesity and pre-diabetes among young adults. Hence our study aims to determine the prevalence of pre-diabetes among year 2 students in a medical school in Malaysia and to gauge their basic knowledge of the relationship of obesity to pre-diabetes.

**Methods:** A cross-sectional descriptive study was carried out on 93 students. HbA1c blood sugar was measured using venous sampling. Participants also answered a close-ended self-administered questionnaire.

**Results:** 7.5% (n=7) of the study population had elevated HbA1c= 5.6-6.2. There was gap in knowledge regarding the pre-diabetic HbA1c values.

**Conclusion:** Our study recorded a 7.5% pre-diabetic prevalence rate among young adults aged 19-25 with a lack of knowledge about the pre-diabetic HbA1c values. This emphasizes the need for preventive action by the educators to produce healthy and competent health care professionals.

**Keywords:** HbA1c; Knowledge; Pre-diabetes

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## Introduction

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia which results from defects in insulin secretion, insulin action or both [1]. The damaging effects of diabetes mellitus is that it unravels oxidative stress [2]. As a continuum, free radicals of oxygen play a main role in causing insulin resistance in these patients [2]. Pre-diabetes is a condition when blood sugar levels are higher than normal, but lower than diabetes thresholds [3]. Prior to the onset of diabetes, there is reduced insulin sensitivity for a period of 13 years and a greatest reduction is observed 5 years before the onset of type 2 diabetes. Hence, around 70% of individuals with pre-diabetes will eventually develop diabetes within a span of 10-13 years [3]. Excess body fat is associated with poor insulin sensitivity and regarded as the single most determinant of type 2 diabetes [1]. The accepted tools to diagnose both diabetes and pre-diabetes are venous blood glucose and glycated Hemoglobin (HbA1c) analysis [4]. Of these two methods, HbA1c is a highly specific and a convenient alternative to fasting plasma glucose for diabetes screening [1]. The International expert committee reports have backed up the usage of HbA1c as a diagnostic tool for pre-diabetes provided the method is standardized and precise [5]. Following this, HbA1c has been accepted as a diagnostic tool by both the American diabetes Association and Korean diabetes association [6].

The International Diabetes Federation predicts that the prevalence of diabetes in South East Asia will increase by two folds by the year 2025 [7]. WHO has estimated that in the year 2030 Malaysia will have a total of 2.48 million people with diabetes. The National Health and Morbidity Survey 2011 (NHMS2011) reported that the overall prevalence of DM was 11.6% and 14.9 % in those aged 18 and 30 years respectively and an increasing trend (15. 5%) in the prevalence of diabetes among adults of 18 years and above [8]. The overall prevalence of pre-diabetes among adults was 22.1% (30.2% in men and 69.8% in women) according to a study conducted in Malaysia by Norlaila M et al., [9]. Another study in Malaysia which used HbA1c as the diagnostic tool, reported the prevalence of diabetes as 22.6% and pre-diabetes as 21.7% [10].

The prevalence of pre-diabetes notably increased with increasing age and increasing weight [11]. The earlier onset of the disease is

important because of the effect on the productive life years and the long term burden on the healthcare system [12].

There is a paucity of data on prevalence of pre-diabetes and the knowledge of relationship between obesity and pre-diabetes among young adults. Hence, our study aims to determine the prevalence of pre-diabetes among year 2 preclinical medical students in a Malaysian medical school and their basic knowledge of the relationship of obesity to pre-diabetes. This is because a large number of university students are at a higher risk of developing DM in their lifetime due to low levels of physical activity, high BMI, lack of knowledge regarding the disease, and its high prevalence in their families [13]. Our hypothesis is there is an increased prevalence of pre-diabetes among the young medical students in par with data from study conducted in young adults of Malaysia (22.1%) and they would exhibit adequate basic knowledge regarding the relationship between pre-diabetes and obesity. This target population was selected because they will be the future health care professionals who play crucial roles in promoting health and prevention of diseases. Hopefully this study will create awareness among the medical students to adopt a healthy lifestyle and also identify the knowledge gap if at all it exists.

## Methods

A cross sectional descriptive study was carried out among year 2 medical students between August 2015 and September 2015.

All second year medical students of the 2014-2015 academic session were invited to participate in the study. Out of a cohort of 130 students, 93 participated in the study and completed the questionnaire (response rate of 71.5%). The participants were selected as per non-random quota sampling method. Sample size was calculated using the following formula, $n = \frac{Z^2 \times P(1-P)}{d^2}$ where n is the sample size required, Z will be 1.96 for confidence level of 95%, p is the estimated prevalence of 22.1% and d is the precision level of half of p [9]. The calculated sample size was 265. The adjusted sample size was 70, which was calculated using the formula $n = \frac{n_0 N}{n_0 + (N-1)}$. The estimated prevalence of pre-diabetes in Malaysian adults determined by HbA1c is 21.7% which is similar to the above study and hence the calculated sample size was considered appropriate [9,10]. All respondents were informed of the objectives of the study and their written consent was obtained prior to participation in this research.

A total of 93 second year medical students consented for this study and met the inclusion criteria of being second year medical students, aged between 19-25 years. Students diagnosed with diabetes or on treatment for diabetes and who were pregnant were excluded from the study.

HbA1c blood sugar screening was conducted by two trained staff nurses who obtained venous blood sampling of the same. The sample was analyzed in the laboratory using Turbidimetry inhibition immunoassay, inter assay CV: 1.4 % with < 2Instrument: Integra 800 (Roche).

HbA1c levels ranging between 5.6-6.2 was considered pre-diabetes as per WHO guidelines [14]. The collected data was kept confidential using password protected laptop and all paper documents were kept under lock and key.

A self-administered questionnaire in English which comprised of two sections was developed based on literature review, and consensus among research team members [13,15,16]. The questionnaire was validated using face and content validity. It was pilot tested among 10% of the sample size and amended accordingly. The two sections of the questionnaire are as follows:

**Section 1:** This section includes age, gender, race and marital status of the participants.

**Section 2:** To assess the basic knowledge of relationship of obesity to pre-diabetes. The answer "unsure" was classified as negative response.

Ethical approval was obtained from University Ethics committee and identities of participants were kept anonymous. Name, facial recognition and any personal information of people or place which appears in interactive learning tools was also kept confidential, unless written consent has been given by the involved party. All the data is presented in percentage values.

## Results

All students (n= 93) included in the study were single and aged 19-25 years. Majority 67% (n=62) were female and 33% (n=31) male. 87% (n=81) of students were Malays, 10% (n=9) Indians, 2% (n=2), Chinese, and 1% (n= 1) was others.

Out of the study population, the prevalence of pre-diabetes with the HbA1c level between 5.6 and 6.2 is 7.5% (n=7). The results of the questionnaire are presented in percentage values as shown in table 1. The students were very sure about obesity being a causative factor for pre-diabetes (97%) and were quite convinced that exercise will reduce the risk of contracting pre-diabetes (89% agreed). However they were quite unsure about the values of the pre-diabetic HbA1c as only 49% could identify the values. 15% claimed it as false and another 34% were unsure. Similar results were encountered when the causal relationship between obesity and pre-diabetes was asked (55% false and 23.5% unsure).

## Discussion

Screening and identifying pre-diabetes in early stages may help to develop strategies to prevent pre-diabetes to diabetes [17]. Screening for pre-diabetes is mandatory in the current scenario as imminent diabetes is one of the components of a cluster of risk factors for cardiovascular diseases [18]. Adding on, these risk factors known as MeTS (Metabolic Syndrome) and NAFLD (Non-Alcoholic Fatty Liver Disease) linked by common pathophysiological mechanisms such as steatosis, central obesity and insulin resistance [18]. Studies conducted in Malaysia, reported that the overall prevalence of pre-diabetes as 22.1% (30.2% in men and 69.8% in women) using blood glucose values and 21.7% using HbA1c values [9,10]. The sample size was calculated based on the prevalence value obtained by blood glucose results because the age group of the participants of the study was much similar to our study. Moreover, the HbA1c study revealed a slightly higher prevalence of 21.7% which did not produce a profound difference while calculating the sample size [10]. Our study reveals 7.5% of the participants had HbA1c in the pre-diabetic range. Though our results are not closer to both the earlier studies, it can be justified that the target population of our study is much younger and hence 7.5% can be taken as a significant value [9,10].

| Question | True | False | Unsure |
|---|---|---|---|
| Glycated Hemoglobin (HbA1c) level between 5.6-6.2 is pre-diabetes | 49% (n=46) | 15% (n=14) | 34% (n=32) |
| Obesity is a risk factor for pre-diabetes. | 97% (n=90) | 3% (n=3) | |
| Obesity induces an oxidative stress with inflammatory changes that disrupts insulin action. | 21.50% (n=20) | 55% (n=51) | 23.50% (n=22) |
| 30-minute brisk walk 5 times a week will reduce/postpone the chances of contracting pre-diabetes. | 89% (n=83) | 2% (n=2) | 9% (n=8) |

**Table 1:** Knowledge on relationship between obesity and pre-diabetes.

The usage of HbA1c is explained by the fact that Asians have higher HbA1c values than whites after adjusting factors such as fasting and post load glucose levels [6]. The reason for racial and ethnic differences lies in different hemoglobin glycation rate and red cell turnover rate [6]. The studies in Korea have shown that the diagnosis of diabetes has doubled since the usage of HbA1c as the diagnostic tool and researchers have suggested for a lower cut-off rate in Asian population to be stringent in the screening [6]. Malaysian researchers have suggested a lower cut off value of HbA1c of 6.3 to diagnose diabetes which further emphasizes the appropriateness of this study [10].

The relationship between obesity and pre-diabetes and type 2 diabetes mellitus is multifactorial. Insulin resistant state of obesity and type 2 diabetes is associated with high plasma concentrations of inflammatory mediators, such as Tumour Necrosis Factor-α (TNF-α) and interleukin-6 (IL-6). There are two possible mechanisms. Firstly, it is suggested that obesity induced by chronic over nutrition (increased glucose and macronutrient intake) causes oxidative stress and inflammatory changes. Secondly, insulin signals transduction and therefore insulin action is suppressed by the increased concentrations of TNF-α and IL-6, due to oxidative stress associated with obesity [19]. These inflammatory cytokines and free fatty acids also activate the c-Jun Amino-Terminal Kinases (JNKs) which are usually responsive to stress stimuli. JNKs in turn interfere with insulin action leading to diabetes mellitus [20]. Interestingly, another pathogenesis pathway has been attributed to low levels of adiponectin in obese individuals which increases the possibility of type 2 diabetes mellitus in these subjects [21].

Researchers who investigated pre-diabetes found higher leptin levels in lean population. Leptin is an adipokine produced by white fat cells. People who have pre-diabetes have higher leptin levels which are associated with increased risk of type 2 diabetes mellitus [22]. Insulin resistance can be independent of obesity in inducing pre-diabetes possibly due to leptin pathway [23]. Since diabetes mellitus is a polygenic disorder, conditions like Maturation Onset Diabetes in Young (MODY) also has to be considered in hyperglycemia of young adults [23].

Our study showed that though the students were aware of the relationship between obesity and Type II diabetes, many were not sure of the pre-diabetes HbA1c level and the pathophysiological mechanism behind the causal relationship between obesity and pre-diabetes (Table 1). However, the students were quite certain that the inculcation of routine exercise would reduce the risk of diabetes substantially. The possible mechanism for the lowering of diabetes risk could be that weight loss enhances adiponectin concentrations which will improve the insulin resistance and prevent the progression of pre-diabetes to diabetes [24].

## Conclusion and Recommendations

Our study is in concordance with the global increase in the prevalence of pre-diabetes among young adults. Since pre-diabetes is subtly present, this study emphasizes that early diagnosis and interventional measures would possibly delay the natural progression of the disease. Pre-diabetics and other high-risk individuals should be advised on lifestyle modifications to delay the onset of diabetes mellitus.

Interventions to reduce diabetes risk should primarily target weight reduction [25]. These individuals should be investigated further for contributing factors like leptin levels and genetic conditions like MODY. Hopefully the outcome of this study would encourage future health care professionals to adopt a healthy lifestyle and also play crucial roles in promoting health and prevention of non-communicable diseases. The students with elevated HbA1c should be followed up with Modified Oral Glucose Tolerance Test (MOGTT) and a repeat HbA1c should be done 4 weeks after the first positive test [14]. Therefore, we strongly recommend that longitudinal studies on this cohort be carried out on an annual basis to provide further valuable input for strategic planning purposes. It is also recommended that healthcare professionals become involved in educational settings to enhance health-related knowledge and inculcate healthy lifestyle practices among medical students. Institutes of higher education should also help to implement appropriate strategy for physical activities and dietary changes to promote weight loss by ensuring the provision of fitness centers in the campus and availability of healthy food in the canteens [26].

## Limitations of the Study

The students in the location of study are majority Malay therefore Chinese and Indians are not proportionally represented in our study sample. Even though small in size, the sample is still are preventative of the population of interest who are the young adults. However, the fact that the study population is from a medical school limits the extrapolation of the data to the general population. Moreover, some high risk students might have opted out of the study due to implications of identification of obesity and pre-diabetes. Another limitation is the use of self-reported data and the assumption that participants responded honestly and accurately.

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