**ORIGINAL ARTICLE**

# MODIFIABLE RISK FACTORS OF CARDIOVASCULAR DISEASE AMONG ADULTS IN RURAL COMMUNITY OF MALAYSIA: A CROSS SECTIONAL STUDY

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## ABSTRACT

*Cardiovascular disease (CVD) is the leading cause of death in Malaysia and many parts of the world. Potentially modifiable risk factors for CVD include diabetes mellitus, hypertension, abdominal obesity, smoking and psychosocial stress. Over the last several decades, efforts to prevent or treat CVD risk factors have resulted in significantly lower rates of CVD-related mortality. However, many patients have never achieved adequate control of CVD risk factors despite them being identified. The aims of this study were to measure the prevalence of cardiovascular diseases and to determine its associated factors. A cross sectional study was carried out in a rural area of Malaysia from March 2011 to November 2011 on 1489 respondents aged 18 and above who were selected via convenient sampling. The survey was conducted via a face-to-face interview using a standardized self administered questionnaire. Prevalence of cardiovascular disease identified was 72 cases (4.8%). Overall, the prevalence of modifiable risk factors were predominant compared to non modifiable, with abdominal obesity (51.2%) hypertension (39.5%) and psychosocial stress (33.8%) being among the highest. However, the prevalence of other modifiable risk factors was relatively low with smoking (25.2%), and diabetes mellitus (10.9%) respectively. Respondent with diabetes mellitus and hypertension were 4 times more likely to have cardiovascular disease and those who are obese had associated 2.5 risks towards cardiovascular disease. Therefore, community health intervention measures should be mobilized, specifically on prevention and control of lifestyle-related risk factors.*

***Keywords:*** *cardiovascular disease, modifiable risk factors, rural area, Malaysia*

## INTRODUCTION

The World Health Organization (WHO) reported that cardiovascular diseases (CVD) are the leading causes of death globally with the estimated 17.1 million people died from cardiovascular diseases in 2004, representing 29% of all global deaths[1]. Of these deaths, an estimated 7.2 million were due to coronary heart disease and 5.7 million were due to stroke. By 2030, about 23.6 million people estimate annually from cardiovascular diseases[2]. Public health services in developing countries presently are overstretched by increasing demands to cope with cardiovascular diseases and its complications. The percentage of premature deaths from cardiovascular diseases ranges from 4% in high-income countries to 42% in low-income countries, leading to growing inequalities in the occurrence and outcome of cardiovascular diseases between countries and populations [3].

Malaysia, being one of the developing countries in the world is currently experiencing its epidemiologic and demographic transition[4]. In Malaysia, cardiovascular disease is the foremost cause of mortality[5]. For several years, morbidity, mortality and hospitalization rates have been persistently in the top five ranks. Mortality due to CVD is not only involving the elderly but also the young adults. The Ministry of Health, Malaysia, had revealed data from 128 hospitals which showed an increasing trend of hospitalization and death cases due to CVD over the past 10 years[2]. Similarly, a study on the total expenditure of prescription drugs in Malaysia for the year 2005 had reported that anti-hypertensive drugs, lipid modifying agents and diabetic drugs accounted for 18.5% of all prescribed drugs with a total amount of RM 2.24 billion[6].

Recent national health data has shown an increase in prevalence related to the clustering of cardiovascular risk factor in Malaysia [7]. Therefore, CVD has been designated as a group of disorders of the heart and blood vessels which include coronary heart disease, cerebrovascular disease, peripheral arterial, rheumatic heart disease, congenital heart disease, deep vein thrombosis and pulmonary embolism1. The underlying pathology of CVD is atherosclerosis which develops over many years and is usually advanced by the time symptoms occur, generally in middle age. The atherosclerosis will reduce coronary blood flow or complete obstruction in a part of the myocardium. These will lead to myocardial lesions which determine the symptom, clinical course and outcome of the disease[2]. Therefore, it is important to study the CVD risk factors that are applicable to risk factors of all cardiovascular diseases.

The CVD outcome can be due to a number of risk factors. Potentially modifiable factors are related to lifestyle and behavior of people such as smoking, obesity, stress, unhealthy diet and physical inactivity, besides the well known diseases especially hypertension, diabetes mellitus and hypercholesterolemia [8].Whereas age, male sex and positive family history with cardiovascular diseases are non-modifiable risk factors. These major risk factors have been responsible for 80% of coronary heart disease and

cerebrovascular disease[9]. Data from the Fourth National Health and Morbidity survey in 2011 showed a population of more than 18 years of age, with hypertension remains the number one risk factor with a prevalence rate of 32.7% (5.8 million), followed by diabetes mellitus 24.8% (2.6 million) and abdominal obesity 15.1% (2.5 million)[5].

Over the last several decades, efforts to prevent or treat CVD risk factors have resulted in significantly lower rates of CVD-related mortality[9]. However, many patients have never achieved adequate control of CVD risk factors although it has been identified. Malaysian Ministry of Health has developed a national strategic plan to tackle the increasing trend of cardiovascular risk factors and diseases [11]. Various strategies and measures have been planned to identify individuals with higher chances of cardiovascular risks as well as to introduce early clinical intervention and management. Besides, many forms of preventive and control measures have been taken such as health promotion campaigns and health screening to overcome this problem [11]. However, the CVD trend nowadays has indirectly shown a less significant impact to the population despite various measures taken by the relevant authorities [9].

Prevention is always better than cure. One way to reduce CVD incidence is by developing greater public awareness of healthy lifestyle, especially among population at risks by educating, screening, detecting and treating the modifiable risk factors. These measures must be drastically taken as most Malaysian population do not practice healthy heart behaviors on routine basis[12].

There is well-documented information about CVD[11] and studies related to CVD risk factors in Malaysia but most of them are less focused to modifiable risk factors in CVD patients [8]. Therefore, the purpose of this study was to measure the prevalence of each important modifiable CVD risk factor among CVD patients. Besides, its specific aim was to assess the association between the risk factors to cardiovascular disease patients. It was expected that modifiable risk factors still act as major risk factors in cardiovascular disease. These findings will be important to optimize the selection of risk-factor targets for population-based or individual-based programs, so as to prevent and reduce the burden of cardiovascular diseases in the studied community as well as in extrapolations to the population of Malaysia.

## METHODOLOGY

A cross-sectional survey was conducted in Tanjung Karang, Malaysia from March 2011 through November 2011, using a convenient sampling strategy. Tanjung Karang district is a rural area located about 200km north of Kuala Lumpur, Malaysia. The district, equipped with all basic amenities of safe water supply, electricity and proper sanitation, has a population of about 16000 with mainly Malay ethnicity.

A sample size of 1963 samplings was estimated using Fleiss J.L formula to detect a prevalence of self-reported cardiovascular disease. The survey was preceded by meeting the community leaders to ensure good participation. Consent was taken from the participants and confidentiality of the survey was assured. All residents aged more than 18 years, Malaysians and living in particular location identified by village community leaders, were invited to participate in this study. Pregnant mothers, psychiatric patients and subjects who refused to give consent were excluded from the study. In this study, results and findings were all conveyed to the subjects and advice was given to subjects with abnormal findings to have follow-up check-ups at their nearest clinics.

Data were collected by means of self administered questionnaire and anthropometric measurements from house to house selected communes by trained and qualified surveyors. The questionnaire was translated into Malay language and validated via back to back translation by certified translators.

The questionnaire included four main sections were a) socio-demographic data (age, gender, ethnicity, current job status, educational level and marital status), b) self-reported medical history such as hypertension, diabetes mellitus, ischemic heart disease, stroke, heart failure, c) behavioral data (smoking history and level of psychosocial stress) and d) anthropometric data (blood pressure, waist circumference, weight and height to measure body mass index (BMI). Factors such as genetic marker, physical activity, diet habit, hypercholesterolemia and other factors were purposely excluded from this study.

For anthropometric measurements, body weight, height and waist circumference were measured strictly by trained and qualified surveyors twice, using validated and calibrated instruments and protocol, previously described elsewhere [12]. Waist circumference was measured at the level midway between the lowest rib margin and the iliac crest. The measurement was performed in duplicate [13]. Systolic and diastolic blood pressure was measured at least twice, within five minutes apart, in a resting and sitting position using a validated automated digital sphygmomanometer (OMRON Healthcare Inc., Bannockburn, Illinois, USA), with an appropriate sized cuff, following a similar standardized protocol as undertaken in the national survey. A third measurement was performed if the difference between the first two measurements was more than 10 mmHg [10].

Cardiovascular disease was defined as a composite endpoint including self-report of ever being diagnosed (by a physician) either with ischemic heart disease, heart failure and/or stroke. Ethnicity group was divided to Malay and non Malay. Family history was defined as a history of any cardiovascular disease in either parents or siblings at any age. Marital status was reported as 2 categories: a) single, separated or divorced/widowed and b) married[14]. Occupational status was classified into two groups: working (professional, technical workers and other related job) and not working (housewives, jobless, disabled) [15]. Educational level, which was determined by years of schooling or level at graduation, was classified into 2 groups: lower schooling (≤9 years of education) and higher (>9 years of education including graduation from high school or higher) [12].

For smoking history, ever smoked is defined as individuals who smoked any tobacco in the previous 12 months and included those who had quit within the past year regardless of the type of tobacco, duration or number[14]. Psychosocial stress was assessed by several direct questions to evaluate whether the participants had any stress at work or at home, any financial stress, any major life events (such as marital separation or divorce, loss of crop or job, major intra family conflict, death, illness of a close family member/spouse, etc.) or any other major stress in the past year at different levels (none, mild, moderate, and severe). People who had more than 2 moderate stressors were classified as having psychosocial stress [8].

Body mass index (BMI) was calculated as weight (kg) divided by height squared (m2) [10]. It was classified as normal (<23.0) and obese (≥23.0). Waist circumference was classified as abdominal obesity either ≥90 cm in men or ≥80 cm in women [10]. Hypertension was defined as self-reported hypertension and current use of anti-hypertensive medication or measured systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg[10]. Diabetes mellitus was defined as subject's report of a physician's diagnosis of diabetes or use of medication for diabetes [16].

Data were weighted for the complex survey design, non-response to questionnaire items or failure to complete some segments of the evaluation. All data were analyzed using Statistical Package for Social Sciences (SPSS) version 20.0.

For descriptive data, the mean, median and standard deviation were calculated. Prevalence of cardiovascular disease and risk factors were obtained within sex and other categories. These CVD risk factors were divided into two groups: non modifiable risk factor (age, gender, ethnicity, current job status, educational level and marital status), and modifiable risk factors (hypertension, diabetes mellitus, smoking status, level of psychosocial stress, BMI and waist circumference). Data were described using mean and standard deviation for continuous variables and proportions for categorical variables. Between-group comparisons of categorical variables were performed using chi-square tests to assess statistical significance of the difference in the percentages of cardiovascular disease according to independent categorical variables. Binary logistic regression analyses were performed to derive the adjusted strength of factors associated to the cardiovascular disease. All tests were two-tailed with significance defined as p value less than 0.05. The ethic was approved by Universiti Kebangsaan Malaysia Medical Centre (UKMMC).

## RESULTS

A total of 1489 respondents agreed and included to participate in the study. Table 1 shows the socio-demographic characteristics. The prevalence of cardiovascular disease found was 72 cases (4.8%).

The age of the respondents ranged from 18 to 91 years. All participants were classified into 10 years age bands: 18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years and more than 65 years. The highest respondent according to age classification was within 35 to 44 years old (22.7%). The mean age was 44.9 years, with a standard deviation of 15.8 years. Gender distribution among study population indicates that there were more females than males in this study. Females were 913(61.3%), males were 576(38.7%). Majority of participants were Malays (94.8%). However, other ethnicities were collapsed as they presented only in small number. Only 11% of the respondents had higher educational level. A total of 46.4% respondents were unemployed and mostly housewives. Approximately 75% were married. Almost one third (36.2%) of the respondents have strong family histories of cardiovascular diseases either among their parents or siblings.

Table 2 delineates the distribution of the modifiable risk factors of cardiovascular risks among respondents. Using the World Health Organization's cut-off points for Asian's population (WHO 2011), 353 of participants were of normal weight and 1136 (76.3%) were obese. Besides, 34.5% of women were noted to have abdominal obesity compared to just 13% in men. The percentage of respondents noted to be hypertensive was 39.5% and only 10.9% of participants had a self-reported diabetes mellitus. However, only 25% (375) of the participants were ever smoked. More than 33% ( 508) had a high level of psychosocial stress.

**Table 1: Socio-demographic data of the respondent (N=1489)**

| Parameter | Frequency | Percentage(%) |
|---|---|---|
| Gender | | |
| Female | 913 | 61.3 |
| Male | 576 | 38.7 |
| Age (Group) | | |
| 18-24 | 194 | 13.0 |
| 25-34 | 217 | 14.6 |
| 35-44. | 338 | 22.7 |
| 45-54 | 305 | 20.5 |
| 55-64 | 247 | 16.6 |
| >65 | 188 | 12.6 |
| Marital Status | | |
| Single/Others | 371 | 24.9 |
| Married | 1118 | 75.1 |
| Ethnicity | | |
| Malay | 1412 | 94.8 |
| Non Malay | 77 | 5.2 |
| Educational Level | | |
| No/Lower | 1326 | 89.1 |
| Upper | 163 | 10.9 |
| Current Job Status | | |
| Working | 798 | 53.6 |
| Not working | 691 | 46.4 |
| Family History CVD | | |
| No | 950 | 63.8 |
| Yes | 539 | 36.2 |

*CVD = Cardiovascular disease*

Mean age of respondents with cardiovascular disease was 44.3±15.6 (t statistic = -8.24). Besides, height of the respondents with cardiovascular disease was 158.4 ± 9.2 and their mean weight was found to be 64.5± 14.90 kg. Their mean body mass index (BMI) was 20.3 ± 4.54 kg/m2. The mean of waist circumference was showed (male 69.4 cm ± 13.2 cm, female 61.6 kg ± 14.3 cm). Mean systolic blood pressure was 125.9 ± 16.4 mmHg and mean diastolic blood pressure measurement was 81.1 ± 11.3 mmHg.

**Table 2: Modifiable risk factors of cardiovascular risk (n = 1489)**

| Parameter | Frequency | Percentage (%) |
|---|---|---|
| Diabetes Mellitus | | |
| Yes | 162 | 10.9 |
| No | 1327 | 89.1 |
| Hypertension | | |
| Yes | 588 | 39.5 |
| No | 901 | 60.5 |
| WC | | |
| Obese | 763 | 51.2 |
| Normal | 726 | 48.8 |
| BMI | | |
| Obese (≥23.0) | 353 | 23.7 |
| Normal(<23.0) | 1136 | 76.3 |
| Cigarette Smoking | | |
| Ever smoked | 375 | 25.2 |
| Never | 1114 | 74.8 |
| Psychosocial stress | | |
| Yes | 504 | 33.8 |
| No | 985 | 66.2 |

*BMI = Body Mass Index*
*WC = Waist Circumference (Obese: ≥90cm (Men), ≥80cm (Female) and Normal:≤90cm(Men),≤80cm(Female).*

The association between socio-demographic characteristics and the prevalence of cardiovascular disease among respondents were analyzed using chi-square tests.

**Table 3: The association between socio-demographic characteristics and cardiovascular disease**

| Parameter | Cardiovascular disease Yes (n = 72) N | % | No (n =1417 ) N | % | $X^2$ | P value | POR (95%CI) |
|---|---|---|---|---|---|---|---|
| Gender | | | | | | | |
| Female | 42 | 4.6 | 871 | 95.4 | 1.12 | 0.284 | 0.89 |
| Male | 30 | 5.2 | 546 | 94.8 | | | (0.54-1.42) |
| Marital Status | | | | | | | |
| Single/Others | 17 | 4.6 | 354 | 95.4 | 0.07 | 0.793 | 1.07 |
| Married | 55 | 4.9 | 1069 | 95.1 | | | (0.62-1.89) |
| Ethnicity | | | | | | | |
| Malay | 69 | 4.9 | 1343 | 95.1 | 0.16 | 0.693 | 0.79 |
| Non Malay | 3 | 3.9 | 74 | 96.1 | | | (0.24-2.57) |
| Educational Level | | | | | | | |
| No/Lower | 68 | 5.1 | 1258 | 94.9 | 2.26 | 0.13 | 0.47 |
| Upper | 4 | 2.5 | 159 | 97.5 | | | (0.17-1.29) |
| Current Job Status | | | | | | | |
| Profesional/ Technical | 32 | 4.0 | 766 | 96.0 | 2.55 | 0.111 | 1.47 |
| Unemployed | 40 | 5.8 | 651 | 94.2 | | | (0.91-2.36) |
| Family History CVD | | | | | | | |
| No | 47 | 4.9 | 903 | 95.1 | 0.07 | 0.789 | 0.93 |
| Yes | 25 | 4.6 | 514 | 95.4 | | | (0.57-1.54) |

*P < 0.05 is considered significant, Chi square test, POR = prevalence odds ratio, CVD = Cardiovascular disease*

In addition, the association between the modifiable risk factor and the prevalence of cardiovascular disease was also assessed using chi-square test as showed in table 4. The results showed significant differences in the rates of cardiovascular disease according to respondents with known diabetes mellitus ($x2 = 73.96$, df = 1, $P < 0.001$) and hypertension ($x2 = 60.86$, df = 1, $P < 0.001$).

**Table 4: The association between modifiable risk factors and cardiovascular disease**

| Parameter | Cardiovascular disease Yes (n = 72) n | % | No (n = 1417) n | % | $X^2$ | P value | POR (95%CI) |
|---|---|---|---|---|---|---|---|
| Diabetes Mellitus | | | | | | | |
| Yes | 30 | 18.5 | 132 | 81.5 | 73.96 | <0.001 | 6.95 |
| No | 42 | 3.2 | 1285 | 96.8 | | | (4.21-11.48) |
| Hypertension | | | | | | | |
| Yes | 60 | 10.2 | 528 | 89.8 | 60.86 | <0.001 | 0.82 |
| No | 12 | 1.3 | 889 | 98.7 | | | (4.49-15.79) |
| WC | | | | | | | |
| Central obesity | 45 | 5.9 | 718 | 94.1 | 3.84 | 0.050 | 0.62 |
| Normal | 27 | 3.7 | 699 | 96.3 | | | (0.38-1.00) |
| BMI | | | | | | | |
| Obese (≥23.0) | 20 | 5.7 | 333 | 94.3 | 0.69 | 0.405 | 1.25 |
| Normal(<23.0) | 52 | 4.6 | 1084 | 95.4 | | | (0.74-2.13) |
| Cigarette Smoking | | | | | | | |
| Ever smoked | 21 | 5.6 | 354 | 94.4 | 0.64 | 0.425 | 1.23 |
| Never | 51 | 4.6 | 1063 | 95.4 | | | (0.76-2.08) |
| Psychosocial stress | | | | | | | |
| Yes | 25 | 5.0 | 479 | 95.0 | 0.03 | 0.872 | 1.04 |
| No | 47 | 4.8 | 938 | 95.2 | | | (0.63-1.71) |

*BMI = Body Mass Index*
*WC = Waist Circumference (Obese: ≥90cm(Men), ≥80cm(Female) and Normal :≤90cm(Men),≤80cm(Female).*
*P < 0.05 is considered significant, Chi square test*
*POR = prevalence odds ratio, BMI = Body Mass Index, WC = Waist Circumference*

Logistic regression was undertaken to examine the impact of the socio-demographic and modifiable risk factor on each of the cardiovascular disease. After adjusting for age, only 3 models containing all predictors were statistically significant, indicating that these models were able to distinguish participants who had the risk factors from those who did not (Table 5).

Logistic regression analysis revealed that age, diabetes mellitus, obesity and hypertension were independent factors related to cardiovascular disease. Table 5 showed that age, diabetes mellitus and hypertension had 4 times higher risk having cardiovascular disease compared to those without this risk factor. Besides, respondents who were obese had associated 2.5 risks towards cardiovascular disease. The total model was significant ($p<0.001$) and accounted 22.0% of the variance in the cardiovascular disease (Nagelkerke R Square = 0.220).

**Table 5: Logistic regression for factors associated with cardiovascular disease**

| Parameter | β | S.E | Wald | Df | P value | aPOR | 95% CI |
|---|---|---|---|---|---|---|---|
| Age | 1.45 | .406 | 12.691 | 1 | 0.001** | 4.25 | 1.92-9.43 |
| Diabetes Melittus | | | | | | | |
| Yes | 1.48 | 0.29 | 25.433 | 1 | 0.001** | 4.40 | 2.47-7.82 |
| No* | | | | | | 1.00 | |
| Hypertension | | | | | | | |
| Yes | 1.31 | 0.35 | 13.662 | 1 | 0.001** | 3.70 | 1.85-7.42 |
| No* | | | | | | 1.00 | |
| WC | | | | | | | |
| Obese (≥23.0) | 0.94 | 0.29 | 10.487 | 1 | 0.001** | 2.55 | 1.45-4.48 |
| Normal(<23.0) | | | | | | 1.00 | |

** Reference group, ** Significant at p<0.05*
*aPOR: adjusted Prevalence of Odds Ratio, df : degree of freedom, CI : confidence interval, S.E : standard error, BMI = Body mass index*

## DISCUSSION

It appeared in this study that a modifiable risk factor which was related to a behavior or lifestyle of a community, played an important role and dominated in cardiovascular disease, thus, it suggested similarities to the study done by Shahwan (2010) [18]. Of all risk factors, hypertension and diabetes mellitus appeared to be the most focused factors as the diseases were mostly related to lifestyles and eating habits of people. Hence, this study[15] was consistent with the global findings, that, there was an association between the risk of coronary artery diseases [1] and unhealthy behavior that needed to be seriously addressed. However it was surprisingly found that direct impact of unhealthy lifestyle such as obesity and smoking were not related to the CVD in this study. It could be hypothesized that either obesity or smoking need to be translated into diseases first such as diabetes mellitus and hypertension before it gives an impact to CVD. Nevertheless, it would lead to other risk factors such as psychosocial stress that could increase incidence of cardiovascular disease.

In Malaysia, hypertension has been independently found to be adversely affected cardiovascular disease in the past five decades [15]. This study showed the level of blood pressure towards the risk of CVD events was consistent, continuous and independent of other risk factors. Hence, this study revealed similar findings to the previous one [1]. It has been ascertained that hypertension affected all age groups including the young. This finding also appeared align to the result reported in the National Health and Morbidity survey (NHMS) which was carried out in 2011 with a prevalence of hypertension among adults above 18 years, was 40.5% [19] in general and and Selangor itself contributed 28.7% . This also in line with finding reported in NHMS (2011) where the prevalence of hypertension was significantly higher in the rural areas at 37.4%. Other studies showed many individuals were unaware of having elevated blood pressure, while those diagnosed with hypertension but being freed from symptoms frequently failed to pay due attention to their treatment, received inadequate or irregular therapy or no therapy at all [20].

This study showed that diabetes mellitus also acts as a modifiable risk factor for CVD. Diabetes

mellitus, both insulin dependent and non-insulin dependent type is one of the main components, as CVD accounts for about 60 per cent of all mortalities in people with diabetes mellitus21. In some age groups, people with diabetes have a two-fold increase in the risk of stroke1. In Malaysia, our population rate for diabetes has reached 14.9% of adults (>30 years old), surveyed recently in 2011 [5]. The prevalence was slightly higher in the rural areas at 15.5%[5]. In Selangor, the prevalence is quite high where 6.5% of the community suffered from diabetes mellitus[5]. Proper primary care prevention is needed for cardiovascular risk assessment as well as essential medicines including insulin can improve health outcomes of people with diabetes mellitus.

However, this study also revealed that among other modifiable risks factors, there were surprisingly, elements that have shown less alarming trend. McDermott (2007) also reported that body mass index had less association towards cardiovascular disease compared to hypertension and diabetes mellitus. However, obesity is still a well established risk factor for cardiovascular disease [23]. Body mass index can indicate and estimate the population-specific risks for CVD. This positive finding has clearly indicated that people have valued the importance of health. It has also indicated and perhaps, proven that the current health campaign has slowly yield its effect [4].

The prevalence of smoking, psychosocial stress and abdominal obesity were all lower than the prevalence reported in the non communicable disease surveillance [5]. This is most probably that non communicable disease surveillance included participants from urban areas where the rates of cardiovascular risk factors were higher and this difference could explain the different prevalence found. In comparison to a rural study in China [15], the current study also found lower rates of cardiovascular risk factors, except for overweight.

Urbanization should also be considered a rational reason to explain the higher prevalence of CVD and its risk factors in rural population[14]. Though Tanjung Karang is considered a small district area, it is situated not far from Kuala Lumpur. Perhaps, this will introduce Tanjung Karang as a better development area and its community might accelerate to modern lifestyle and westernization. This might probably increase the burden of CVD indirectly [24.] Thus, taken in this sense, these results may have further public health implications.

Studies have proven that CVD is the major threat to modern society and according to the report, it will remain so at least by 2020[25]. Therefore, all efforts invested in the study of cardiovascular disease are fully justified. New research projects should be focused on prevention and early detection of the disease, improvement of diagnostic procedures, introduction of novel therapeutic options and survey on measures, be taken in due course. This is because CVD poses great socioeconomic burden upon every community because of its younger age onset connection [24]. Actions should be taken to improve awareness of the CVD risks and morbidity in the population and stimulate healthy lifestyle and dietary modifications [20].

Since Malaysia is going through its epidemiological transition, it faces the better prospect of even higher prevalence in the future. A comprehensive program and concerted effort needs to be put into place if improvement is to be achieved especially related to behavior and lifestyle-linked biological factors. Based on the findings, it was ideal if public health approaches be geared into developing new objectives and strategies in controlling the risk towards diabetes mellitus and hypertension[3]. Besides exercises, promotion activities must also be strengthened as good as controlling the overeating phenomena. These strategies will help to reduce the prevalence of obesity in the population starting in younger ages. Overall, this will indirectly reduce the prevalence of morbidity and mortality in cardiovascular disease itself.

This study has several limitations with the cross-sectional nature precludes an assessment of the temporal ordering of each modifiable risk factor and the onset of CVD. Further longitudinal studies will be needed to obtain an accurate picture of the risk factors for cardiovascular disease. The potential for recall bias and misclassification cannot be excluded. The usage of self reported health behaviors especially cigarette smoking status, number of cigarettes per day may have been under reported or the participants may deny their smoking behavior. Fasting Blood Glucose or blood HbA1c is better to counter checking on the diabetes status. However, despite these limitations, this study provides important data on prevalence of the risk factors and its association to cardiovascular disease among adulthood in rural setting in Malaysia.

## CONCLUSION

In summary, this analysis validates that hypertension, diabetes mellitus and obesity are the major modifiable risk factors associated with increases in CVD among adult in rural. The findings were similar to comparison groups, national and global studies. Therefore, it can be used to measure cardiovascular risk in the context of population-based surveys and health promotion strategies as it has become a public health concern in developing rural areas.

**COMPETING INTERESTS**
The authors declare that they have no competing interests.

**AUTHORS' CONTRIBUTION**
All authors were involved in the conception and design of the study, acquisition of data as well as drafting of the manuscript. All the authors have read the final manuscript and have given their approval for it to be presented in its present form.

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