Original Article

A Preliminary Study on the Prevalence of Cardiovascular Disease Risk Factors in Selected Rural Communities in Samarahan and Kuching Division, Sarawak, Malaysia

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Abstract

Background: **It is important to understand the prevalence of risk factors for cardiovascular disease, especially in a rural setting.**

Methods: **A cross-sectional study was carried out in 238 rural households located in the Kuching and Samarahan divisions of Sarawak among individuals aged 16 years and above. Anthropometric measurements, blood levels of glucose and cholesterol, and blood pressure were collected.**

Results: **Prevalence of blood pressure in the hypertensive range was 43.1%. The highest rates of blood pressure in the hypertensive range were found in individuals aged above 60 years (38.6%) and 50–59 years old (31.8%). Age was one factor found to be significantly associated with blood pressure in the hypertensive range (P < 0.001). Prevalence of obesity was 49.0%. The highest prevalence of obesity was found among those aged 40–49 years (41.9%) and 50–59 years (29.9%). Gender was significantly associated with obesity (P = 0.004). The prevalence of blood cholesterol at risk was 21.6%, and the highest rate was found in the 40–49 years age group (34.0%). Fifty percent of respondents were found to have hyperglycaemia, with the highest prevalence in the 50–59 years age group (37.5%). A significant association was found between obesity, blood pressure in the hypertensive range and blood glucose level. When compared with non-obese individuals, those who were obese were more likely to have blood pressure in the hypertensive range and hyperglycaemia.**

Conclusion: **The risk of developing lifestyle-related diseases is no longer based on geographical or socio-economic factors.**

Keywords: *blood pressure, cardiovascular diseases, hypercholesterolaemia, hyperglycaemia, medical screening and epidemiology, risk factors, rural communities*

Introduction

Mortality rates from coronary vascular disease, stroke, cancer, and diabetes are currently increasing in most industrialised countries, and they account for almost 5.5 million deaths annually in developed regions (1). In Malaysia, as in many other developing and developed countries, the major causes of morbidity and mortality have shifted from communicable to non-communicable diseases. Two of the leading causes of death in Malaysia in 2005 were heart disease and cerebrovascular disease (2). The Malaysian Ministry of Health's annual report (3) indicates that mortality from heart and pulmonary diseases accounted for 10.31% of all deaths. These 2 diseases were also classified among the top 10 causes of hospitalisation in government hospitals. It is well known that these non-communicable diseases can often be prevented through lifestyle changes, particularly modification of risk factors such as obesity, hypertension, hypercholesterolaemia, and hyperglycaemia.

Low-income communities are always associated with poverty-related diseases (4). Fundamental changes in food supply patterns in recent decades have led not only to the increase in the amount of food available, but also to the changes in diet composition.

The implementation of public interventions that encourage a healthy lifestyle may need to be reviewed to determine whether the delivery should be targeted to the entire population or catered specifically to affected groups. This is particularly relevant where data on the cardiovascular disease (CVD) risk factors in the rural community are inadequately published. The objective of this study was to determine the prevalence of cardiovascular disease risk factors in selected rural communities in Sarawak, Malaysia.

Subjects and Methods

Sarawak, situated on the island of Borneo, is the largest state in Malaysia, with an area of 124 000 km^2 (37.5% of the country's total land mass). With a population of approximately 2.4 million, Sarawak is the least densely populated of Malaysia's 13 states. Based on geographical classification, there are 11 divisions with 31 districts in Sarawak. Under the criteria of peripheral or adjacent areas of a city or town, 2 divisions were chosen: Kuching and Kota Samarahan. A district was randomly selected for both divisions. A list of rural villages was collected from the state district office, and 5 villages were randomly selected from each district. With the help of the respective Sarawak Administration Officers, informed consent forms were sent out to the head of each village. Of all the villages to which informed consent forms were sent, only 3 agreed to participate in the study (Table 1). Baseline data on population size was then obtained through surveys administered in each of the villages.

The minimum sample size for this cross-sectional study was determined using the formula for single proportion (EpiInfo 3.3.2, Center for Disease Control and Prevention, US). Based on a 25% national prevalence of CVD and a sampling frame of 4128, the minimum sample size to achieve at least a 95% confidence rate was estimated to be approximately 269, which allowed for 10% non-response. The precision of the prevalence of CVD chosen was 5%. Sample size for each village was determined based on its proportion of the sampling frame.

The survey was administered in 2007. Ethical approval was obtained from the Ethics Committee of Universiti Malaysia Sarawak. All residents aged 16 years and above in the selected households were recruited. As the financing was limited, a 1-day event was organized in each of the villages, and all the identified households were invited and gathered at the community hall. The village heads informed all respondents in advance to fast overnight. A participant would be classified as a non-responder if he or she did not attend the event. An informed consent was obtained from each survey respondent. The data collection was carried out in the morning to enable respondents to have their breakfast after the blood test. Data were collected by 2 of the authors using a pre-tested and validated questionnaire. The information collected included the following items:

- Family socio-economic and demographic background
- Body mass index
- Blood pressure
- Blood cholesterol level
- Blood glucose level

Blood pressure measurements were taken using a mercury column sphygmomanometer (Accoson, UK) based on the Malaysian Clinical Practice Guidelines on Management of Hypertension (5). Although blood pressure was taken twice to determine an average reading, this study could only determine the prevalence for blood pressure in the hypertensive range. To make a diagnosis of hypertension, blood pressure must be taken on 2 or more separate occasions or clinical visits. Classification of blood pressure was based on the schema used by the Ministry of Health (5); a systolic reading of 140 mmHg and above and/or a diastolic reading of 90 mmHg and above was classified as hypertensive. For the measurement of body mass index (BMI; weight in kg divided by height in m^2), height was measured using a body meter (Seca, UK) suspended upright against a straight wall, and body weight was measured using a digital weighing scale (Seca, UK). Classification of BMI was based on

Table 1: List of villages enrolled in the study

Village identified	No. of Population	*n* (%)
Kampung Buntal, Kuching	2482	161 (59.9)
Kampung Baru, Samarahan	1035	67 (24.9)
Kampung Pangkalan Kuap, Kota Samarahan	611	41 (15.2)

the World Health Organization/International Association for the Study of Obesity/International Obesity Task Force (WHO/IASO/IOTF) guidelines (6), where a BMI of 23 kg/m^2 and above is classified as overweight and a BMI of more than 25 kg/m^2 is classified as obese. Due to limitations of delivery and laboratory arrangement, blood cholesterol and glucose levels were determined using a handheld Accutrend cholesterol meter and Accu-Chek Advantage meter (Roche Diagnostics, Germany), respectively. Blood was obtained using the finger stick skin puncture method with disposable lancets based on Lynn (7). Classification of fasting total cholesterol and glucose levels was based on National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) (8) and the Malaysian Diabetes Mellitus Guidelines (2009) (9). Based on these guidelines, fasting total cholesterol of more than 5.2 mmol/L is classified as borderline high and 6.2 mmol/L and above is high risk for hypercholesterolaemia. For blood glucose level, any reading of more than 5.6 mmol/L is classified as high risk for hyperglycaemia.

Data was analysed using SPSS version 14 (SPSS Inc., Chicago, IL), which included common descriptive analyses. Significant associations between variables were determined using inferential statistics, based on a *P* value of less than 0.5. Data were cleaned and checked for normality. Odds ratios were presented based on a 95% confidence interval (CI).

Results

A total of 238 respondents agreed to participate in the study, giving a response rate of 88.4% (238 out of 269). The age range for this study was 16–89 years, with a mean of 49.9 years. Distribution of gender was relatively even (46.5% were males and 53.5%, females). The majority of the respondents were Malays, with only 1% were Iban and 1%, Kadazan. Table 2 presents the clinical characteristics of the studied population. Looking at the number of cardiovascular risk factors displayed by participants, 31.5% had 1 risk factor, and 44.4% had more than 1 risk factor.

Table 3 shows the prevalence of blood pressure in the hypertensive range, obesity, blood cholesterol level, and blood glucose level in the at-risk range and their relationships with socio-demographic factors. The prevalence of blood pressure in the hypertensive range was 43.1%. Within the affected group, the highest percentage was found among the older age group (above 60 years), and the prevalence of high blood pressure increased as age increased. This difference was found to be significant (P = 0.001). Females were found to have higher blood pressure readings than males, but this difference was not significant (P = 0.413). The systolic blood pressure (SBP) of the respondents ranged 90–180 mmHg, with a mean of 125.3 mmHg (SD 13.8). The diastolic blood pressure (DBP) ranged 50–100 mmHg, with a mean of 80.9 mmHg (SD 12.2). The mean SBP for males (125 mmHg, SD 12.6) was not significantly different from that of females (125 mmHg, SD 14.8). Similarly, the mean DBP for males (81 mmHg, SD 13.9) was not significantly different from that of females (81 mmHg,SD 10.5).

The prevalence of obesity was 49.0%. The highest rate of obesity was found among those who were 40–49 years old (41.9%), followed by those who were 50–59 years old (29.9%). The mean BMI was 25.26 kg/m^2 (SD 5.04). The BMI of respondents ranged 11.58–56.29 kg/m^2. Obesity prevalence was higher among females than males.

The blood cholesterol level of the respondents ranged 2.59–7.71 mmol/L, with a mean of 4.6 mmol/L (SD 0.8). The cholesterol level increased as age increased, with the highest levels found in the 50–59 year-old age group. Females were found to have higher blood cholesterol levels than males.

The blood glucose levels ranged 0.3–28.0 mmol/L, with a mean of 7.4 mmol/L (SD 3.4). Similar to blood cholesterol level, blood glucose level showed the same pattern of increasing with age. The age group with the highest prevalence of at-risk blood glucose levels was the 50–59 year-old group. This difference was found to be significant (P = 0.008). In terms of gender, males had higher blood glucose levels than females.

In determining an association between BMI and hypertension, the study found that those who were obese were 2.6 times more likely to have blood pressure readings in the hypertensive range than those who were not obese (Table 4). Similar patterns were found for blood glucose level; obese participants had 2.9 times the risk of having at-risk blood glucose levels than those with a normal BMI. All these associations were found to be significant.

Discussion

The overall prevalence of blood pressure in the hypertensive range was higher in our study (43.1%), compared with the 36.9% in rural areas reported in the 3rd Malaysian National Health and Morbidity Survey (NHMS 3) (10). This could be due to the mean age of 49.87 years old in our

Table 2: Clinical characteristics of the studied population

Characteristics	All (n = 238)		Males (n = 111)		Females (n = 127)	
Age (year)	49.87	(11.83)	52.97	(12.08)	47.17	(10.95)
Weight (kg)	62.37	(14.16)	63.52	(14.73)	61.38	(13.63)
Height (m)	1.57	(0.08)	1.62	(0.07)	1.53	(0.06)
BMI (kg/m^2)	25.26	(5.04)	24.19	(4.91)	26.18	(4.99)
Systolic BP (mmHg)	125.28	(13.78)	125.36	(12.6)	125.22	(14.77)
Diastolic BP (mmHg)	80.92	(12.24)	81.18	(13.99)	80.7	(10.53)
Total cholesterol (mmol/L)	4.56	(0.82)	4.47	(0.74)	4.63	(0.87)
Fasting blood sugar (mmol/L)	7.40	(3.39)	7.62	(3.49)	7.21	(3.29)

Data are expressed in mean (SD).
Abbreviations: BMI = body mass index, BP = blood pressure

Table 3: Prevalence of blood pressure at hypertensive range, obesity, blood cholesterol level, and blood glucose level at risk of cardiovascular diseases in relation to age group and gender

Factors	Blood pressure at the hypertensive range[c] (n = 44)		Obesity (n = 117)		Blood cholesterol at risk[d] (n = 50)		Blood glucose at risk[e] (n = 120)	
Age group (years)[a]								
<39	4.5	(2.4,12.1)	12.8	(22.1,53.0)	12.0	(3.0,26.6)	10.0	(15.2,44.3)
40–49	25.0	(6.7,21.4)	41.9	(49.0,71.4)	34.0	(12.2,29.5)	30.0	(32.0,54.4)
50–59	31.8	(11.2,30.8)	29.9	(39.3,64.0)	32.0	(13.6,33.7)	37.5	(54.3,77.1)
>60	38.6	(21.1,49.0)	15.4	(23.0,52.1)	22.0	(11.0,35.3)	22.5	(42.9,71.2)
P value	0.001		0.083		0.724		0.008	
Gender[b]								
Male	40.9	(9.6,23.5)	39.9	(32.0,50.0)	40.0	(11.0,25.5)	51.7	(46.0,65.3)
Female	59.1	(13.2,27.0)	60.1	(48.8,65.1)	60.0	(16.3,31.0)	48.3	(36.1,54.0)
P value	0.413		0.004		0.192		0.136	

Data are expressed in prevalence in percentage (95% confidence interval). Statistical analysis was done using [a]Fisher exact test and [b]chi-square test. [c]Blood pressure at hypertensive range (systolic ≥140 mmHg and/or diastolic ≥90 mmHg) , [d]Blood cholesterol level >5.2 mmol/L, and [e]Blood glucose level <5.6mmol/L were considered as at risk of cardiovascular diseases.

study population, which is much older than the mean age nationally. In comparison with other Asian countries, the prevalence of blood pressure in the hypertensive range reported herein was higher than that reported for the adult urban and rural populations of China (11) and other countries (11,12).

The prevalence of hypertension varies between 15% and 35% in urban adult populations of Asia. In rural populations, the prevalence is 2 to 3 times lower than that in urban populations (12). However, in the NHMS 3 (10), rural areas were found to have a higher prevalence of hypertension than urban areas. One possibility is that the rural population in Malaysia is older than the urban population, and the risk of hypertension increases with age. Looking at gender specifically, our study found that females had a higher prevalence of blood pressure in the hypertensive range than males (59.1% versus 40.9%, respectively);

Table 4: Association of blood pressure at hypertensive range, obesity, blood cholesterol and glucose at risk to obesity

Factors	Category of BMI						*P* value	Odd ratio (95% CI)
	Non-obese		Obese		Total			
Blood Pressure								
Normal	107	(55.2)	87	(44.8)	194	(100)	0.007	2.635
At risk[a]	14	(31.8)	30	(68.2)	44	(100)		(1.32, 5.28)
Blood cholesterol level								
Normal	101	(53.4)	88	(46.6)	189	(100)	0.149	1.664
At risk[b]	20	(40.8)	29	(36.1)	49	(100)		(0.88, 3.15)
Blood glucose level								
Normal	76	(63.9)	43	(36.1)	119	(100)	<0.001	2.906
At risk[c]	45	(37.8)	72	(60.5)	119	(100)		(1.72, 4.92)

Data are expressed in number of participants (percentage). Statistical analysis was done using chi-square test. [a]Blood pressure at hypertensive range (systolic ≥140 mmHg and/or diastolic ≥90 mmHg) , [b]blood cholesterol level >5.2 mmol/L, and [c]blood glucose level <5.6mmol/L were considered as at risk of cardiovascular diseases.
Abbreviations: BMI = body mass index.

however, these differences were not significant. This finding is consistent with the Malay sample in Singapore (13), but it contradicts a national study in Malaysia (14). This is likely due to the fact that more than one-third of the studied population was more than 60 years old and may have undergone menopause, thus their endogenous oestrogen levels were lower and the protective effect of oestrogen on blood pressure was diminished. However, as this is a preliminary study, a more comprehensive study should be done to confirm this finding.

Participants who were above 60 years old had the highest prevalence of blood pressure in the hypertensive range (38.6%) compared with other age groups. This finding is consistent with 2 local studies (15,16) and the study on the adult population in China (11); hypertension, namely systolic hypertension, has been shown to increase with age.

The overall mean BMI was 25.26 kg/m^2, with the highest obesity rate (41.9%) found among those in the 40–49 year-old age group. The overall prevalence of obesity was 49.0%, a figure that is alarming when compared with studies in other Asian countries, including China (11,17,18) and India (19). This figure is comparable to the findings of a study that involved 4 communities of Latin American countries where a BMI of more than 25 kg/m^2 was seen in more than 50% of their populations (20).

The prevalence rate of obesity reported by the NHMS 3 (10) was 29.1%. However, this figure reflects the BMI classification previously used by the Ministry of Health (21), wherein obesity was set at BMI of more than 30 kg/m^2. The latest BMI classification for obesity established by WHO/IASO/IOTF (6) was set at 25 kg/m^2. Females had a higher prevalence of BMI in the obese range than males: 60.1% and 39.9%, respectively. This finding is consistent with other local studies (10,15) in which females were found to have a higher prevalence of obesity than males. This issue has become an emerging paradox in most developing countries. A possible explanation is that females tend to gain the greatest amount of weight during their childbearing years (between 25 and 44 years old) (22). Some women engage in binge eating, even though food is consistently available (23). As the studied population comes from rural areas, another possible cause of obesity among females is the consumption of cheaper and less nutritious (more calorie-dense) food. The lack of choices with respect to availability and type of food can influence the intake of food.

The mean cholesterol levels of males and females were 4.47 mmol/L (SD 0.74) and 4.64 mmol/L (SD 0.87), respectively. These findings were comparable to those reported in a study in a rural population in India (19), but they were lower than those reported in a study of a rural population in Papua New Guinea (24). There was no significant difference by gender; both males and females had mean blood cholesterol level of less than 5.2 mmol/L, as recommended by the NCEP ATPIII (8). Based on this cut-off point, 21.6% of participants were found to be at high risk of hypercholesterolaemia, with the 40–49 age group having the highest prevalence of at-risk cholesterol levels (34.0%), followed closely by the 50-59 age group (32.0%). The overall prevalence rate was similar to that reported in a study in Singapore where the overall prevalence for both males and females was 23.5% (13). However, this prevalence is lower than that reported in urban and rural populations in China (11), even though the Chinese population has a lower prevalence of hypertension. This is rather interesting as cholesterol level is usually associated with hypertension. This difference could be due to ethnic variation, as the majority of the respondents in this study consisted of Malay and the Chinese study consisted only of Chinese. The cultural practices that influence behaviour in terms of eating and socializing could have contributed to this difference in health status. This study found that females had a higher prevalence of blood cholesterol in the at-risk range than males, which contradicts the study conducted in Singapore (13). However, the differences found in this study were not significant.

The blood glucose profile followed a slightly different pattern than blood cholesterol profile, where the highest prevalence for blood glucose in the at-risk range was among the 50–59 year-old age group (37.5%), followed closely by the 40–49 year-old age group (30.0%). This finding differs from the studies by Norimah and Haja (16) and Rampal et al. (25) in which both blood profiles increased with age. One possible explanation is that the older group's blood glucose level may have been under control due to medication. This study did not explore the question of whether respondents were previously diagnosed and were already under medical treatment or follow-up; therefore, this possibility cannot be explored further.

The overall mean blood glucose levels found herein were higher than those found in the rural population in China (11), with a difference of 2.5 mmol/L. It must be noted that the consumption of high sugar foods is very common in rural communities, particularly among the Malays; their drinks and cuisine tend to be high in sugar. Studies in Singapore (13) also report higher consumption of total energy among Malays than among Chinese.

As individuals approach the age of 50 and above, the chances of having more than 1 risk factor for CVD increases. We found that 44.4% of the participants had more than 1 risk factor, and 49.0% of the respondents were obese and thus more likely to have hypertension, hypercholesterolaemia, and hyperglycaemia than their non-obese counterparts. Female respondents showed a relatively higher prevalence of obesity, hypertensive blood pressure readings, and hypercholesterolaemia than males. Further studies need to be done to assess the main contributing factors associated with obesity, hypertensive blood pressure, and hypercholesterolaemia in this group of females.

Although it was speculated that the CVD risk factors for this rural population would occur in similar patterns to other rural communities (17,24), the findings indicated otherwise. In this survey, the prevalences of all CVD risk factors (BMI, SBP, DBP, total cholesterol, fasting blood glucose) were high, which was similar to the patterns found in an urban population in China (18). One possible reason could be that the villages were located adjacent to the city and thus were exposed to the influence of urbanization. Such influences include those that affect lifestyle and eating behaviours.

This is a preliminary study assessing the prevalence of several modifiable CVD risk factors. Because this study was carried out among selected villages in the rural areas of Kuching and Samarahan division, generalisation can only be extended to other sites with similar socio-demographic characteristics. The determination of cholesterol and glucose by finger-prick method was a preliminary screening and only provided initial information regarding the state of the respondents. Further comprehensive diagnostic measures would be needed to confirm the condition of respondents. Additional information about CVD-related disease status, family history of CVD-related disease, behavioural risk factors, eating habits, and smoking would help us to understand more about the relationship between CVD and its risk factors. We hope that with these preliminary findings, a more comprehensive study can be carried out in the future.

Conclusion

The overall results indicate that the risk of developing lifestyle-related diseases is no longer based on geographic or socio-economic factors, including the differences between urban and rural populations. Assessment of the effectiveness of current health interventions needs to be carried out more frequently to ensure that all segments of society acquire the necessary knowledge. Various health promotion modalities, such as mobile health screening clinics and radio shows, should be carried out at the community level to reach villagers, and these health promotion activities should be continuously monitor and motivate community to change their lifestyle and eating habits. In addition, public health capacity and infrastructure must be strengthened in rural areas to provide adequate surveillance and the assurance that best practices are implemented. Moreover, future approaches in the design and delivery of health education need to consider the factors discussed here.

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Authors' Contributions

Conception and design, obtaining of funding, analysis and interpretation of the data, drafting of the article: CWL
Provision of study materials or patients, collection and assembly of data, administrative, technical, or logistic support: CWL, KY, RAW
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