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Cardiovascular Disease Risk in a Semirural Community in Malaysia

Chia Yook Chin, MBBS, FRCP, and Srinivas Pengal, MBBS, FRCP

Background and aim. It has been argued that cardiovascular disease (CVD) is not very prevalent in developing countries, particularly in a rural community. This study examined the prevalence of CVD risk of a semirural community in Malaysia through an epidemiological survey. Methods. Subjects were invited to a free health screening service carried out over a period of 6 weeks. Then, a follow-up study of the initial nonresponders was done in the villages that showed a poorer response. The survey was conducted using a standardized questionnaire. Hypertension was defined as blood pressure \( \geq 140/90 \) mm Hg. The Framingham Coronary Disease Risk Prediction Score (FRS) was used as a measure of CVD risk. Results. A total of 1417 subjects participated in this survey. The response rate was 56%. A follow-up survey of the nonresponders did not show any differences from the initial responders in any systematic way. The prevalence of CVD risk factors was high in both men and women. The mean (±SD) FRS was 9.4 (±2.5) and 11.3 (±4.1) for men and women, respectively. The mean predicted coronary heart disease (CHD) risk was high at 20% to 25% for men and medium at 11% to 13% for women. Overall, 55.8% of the men had >20% risk of having a CHD event in the next 10 years whereas women’s risk was lower, with 15.1% having a risk of ≥20%. Conclusion. The prevalence of CVD risk even in a semirural community of a developing country is high. Every effort should be made to lower these risk factors.

Keywords: epidemiology; prevalence; cardiovascular disease; prediction; risk; rural community; developing country

It has been variously argued that cardiovascular disease (CVD) is not as prevalent in developing countries of low and medium income as in high-income developed countries. Yet data on causes of death continue to show CVD as the number one cause in most parts of the developing world. In fact, the prevalence of and mortality due to CVD may even be higher in developing countries than in developed countries, which are now actually seeing a reduction in CVD mortality. Furthermore, data have shown that urban populations have higher CVD risk than the rural community. There is also a scarcity of

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well-documented data from developing countries about the prevalence of CVD. In addition, many deaths in developing countries are not medically certified and even when certified are at best very approximate estimates of CVD mortality and therefore could be underestimating the actual prevalence.

This study examined the prevalence of CVD in a semirural community in Malaysia, a developing country.

Methods

An epidemiological survey was conducted in 1993 in the Kuala Langat District, a semirural community in Malaysia. The district is about 85 km from the federal capital. Banting is the main town of the district and it has a district hospital with about 200 beds. The district has all the basic amenities of safe water supply, electricity, and proper sanitation. This study is a cohort study to evaluate CVD risk in the community. For this discussion, we will be reporting the findings of the initial epidemiological survey.

Several preparatory meetings were held with the village heads and community leaders prior to the survey in order to encourage and enlist their cooperation in identifying eligible participants. As a consequence of this, all residents aged 55 years and older identified by the village heads and community leaders were invited to participate in a free health screening service. The screening was conducted in local community halls and local government health clinics on a daily basis, village by village over a 6-week period.

The response varied between different villages, where in some villages the response was 90% whereas in others it was lower. Of those who had a lower response, the poor attendance was because of inclement weather that prevented participants from attending. In one of the villages, the lower response was because of a previous bad experience where X-rays were taken and subjects were not told of the findings. In this study, results and findings were all conveyed to the subjects and advice was given to subjects with abnormal findings to have a follow-up at their nearest clinic. Thus, a follow-up survey at the end of 6 weeks was conducted on the nonresponders in the villages that had a low response.

Demographic data were collected and the questionnaire applied to them by interview. Physical examination, measurements, and blood investigations were done on all the initial responders. However, blood investigations were not performed on the follow-up survey of the nonresponders. These initial nonresponders were not included in the final analysis of this study.

The participants were advised to come in the morning after an overnight fast. A standardized questionnaire was applied by interview by the investigators, trained nurses, and interviewers. Demographic data as well as history of CVD risk factors, including smoking, diabetes, and hypertension were captured. Measurements of weight, height, waist and hip circumference were made according to standard procedure. Sitting blood pressure (BP) was measured according to standardized procedure using a standardized mercury sphygmomanometer. After a rest of 10 minutes, 2 BP measurements were taken 5 minutes apart on either arm. The average of these 2 readings was used as the BP reading of the subject. Fastiging triglycerides, total cholesterol, and high-density lipoprotein (HDL) cholesterol were measured by the enzymatic cholesterol esterase method on a Siemens machine. Low-density lipoprotein (LDL) cholesterol was calculated based on the Friedewald formula. Fasting plasma glucose was measured by the enzymatic hexokinase method on a Siemens machine. All these chemical tests were conducted at the certified and validated laboratory of the University of Malaya Teaching Hospital.
Current smokers were defined as those smoking in the past 1 month. Hypertension was defined as BP ≥140/90 mm Hg. Hypercholesterolemia or abnormal lipids was defined as total cholesterol ≥6.24 mmol/L, low HDL as <1.04 mmol/L and high LDL as ≥4.16 mmol/L. Diabetes was defined as fasting plasma glucose level ≥7 mmol/L. These definitions are in keeping with the established guidelines for the diagnosis and management of hypertension, dyslipidemia, and diabetes mellitus, respectively.

The Framingham Coronary Heart Disease Risk Prediction Score (FRS) based on total cholesterol was used as a surrogate measure of CVD risk. The total point score for each individual was computed and the 10-year coronary heart disease (CHD) risk was subsequently derived from the CHD risk score chart. A risk of >20% was deemed as high risk, between 10% and 20% as medium risk and <10% as low risk. Separate charts were used for men and women.

Ethics approval for this study was obtained from the Ethics Review Board of the University of Malaya Teaching Hospital. Verbal consent was taken from the participants. All data were analyzed using SPSS version 11.3 for Windows.

Results

A total of 1417 subjects participated in the survey. The overall response rate was 56%. The total number of subjects in resurvey of 3 villages with poor response (ie, initial nonresponders) was 98.

The mean (±SD) age of the subjects was 65.4 years (±8); range = 55 to 95 years; 53.4% were men and 46.6% women. Nearly half (46.2%) were 65 years or older. The main ethnic groups were Malays (70.4%), Chinese (16.2%), Indians (13.0%), and others (0.4%).

The mean age of the initial nonresponders was 65.2 ± 7.8 years. Overall, 52% and 47% were men and women, respectively, and 47% were 65 years or older. There were no other differences in the other parameters in any systematic way between the initial nonresponders and original responders.

Table 1 shows the demographics and means of CVD risk factors of the participants and Table 2 shows the prevalence of CVD risk factors.

As can be seen from Table 2, the prevalence of CVD risk factors is high in this community. The mean systolic BP is in the stage I hypertensive range. More than half of the participants are hypertensive, of whom only 18.8% were reported and the remaining 33.5% were undiagnosed. The prevalence of diabetes mellitus is also high, reported being 10.7% and a further 10% probably undiagnosed based on the measured fasting plasma glucose of ≥7 mmol/L. Again, more than half have total serum cholesterol of greater than the desired upper limit of 5.2 mmol/L. Nearly two thirds of the subjects have LDL-cholesterol levels ≥3.4 mmol/L and about a third have low HDL-cholesterol. Smoking rates were also high, with more than half the men being current smokers.

Figures 1 and 2 show the distribution and means of the FRS for men and women, respectively. The mean Framingham Point Score was 9.4 ± 2.6 and 11.3 ± 4.1 for men and women, respectively.

Table 3 shows the mean FRS and their corresponding predicted CHD risk for men and women, and for those younger than and older than 65 years of age. It can be seen that the men carry a high and the women a medium CHD risk. As expected, the older age group carried a higher CHD risk than their younger counterparts.

Figure 3 shows the distribution of the 10-year predicted CHD risk categories based on the FRS for the men and women. As can be seen, more than half of the men (55.84%) have
high risk (>$20\%$) of a coronary event in the next 10 years. On the other hand, about half (51.4\%) of the women had a medium risk.

**Discussion**

The high prevalence of CVD risk factors seen in this study is consistent with similar findings in other parts of the developing world$^{26}$ as well as in countries from the Asia Pacific region.$^{27}$ It is also consistent with mortality data that indicates that CVD is the number one cause of death in low-income and middle-income countries.$^{13,18}$ In fact, whereas most developed countries are seeing a fall in mortality due to CVD over the past 2 decades,$^{28,29}$ the emerging market economies are actually showing a rise to the extent that the rates are now similar to those seen in the United States in the 1960s.$^{30}$

Smoking is one of the risk factors for CHD and the prevalence of smoking among men in this study is high (54.2\%). This prevalence is similar to that seen in other developing countries in the region$^{26}$ and is higher than the rates seen in the INTERHEART study in which 52 countries participated.$^{31}$ In the INTERHEART study, 45.2\% of those who had a

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**Table 1.** Demographics and Means of CVD Risk Factors of the Participants

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean ± SD</th>
<th>All (N = 1417)</th>
<th>Males (n = 757)</th>
<th>Females (n = 660)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>65.4 ± 8</td>
<td>66.4 ± 8.3</td>
<td>64.1 ± 7.5</td>
<td></td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>140.9 ± 26.8</td>
<td>139 ± 25.9</td>
<td>142.8 ± 27.8</td>
<td></td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>81.3 ± 13</td>
<td>80.8 ± 13.6</td>
<td>82.0 ± 12.3</td>
<td></td>
</tr>
<tr>
<td>Total cholesterol (mmol/L)</td>
<td>5.8 ± 1.2</td>
<td>5.6 ± 1.16</td>
<td>6.0 ± 1.22</td>
<td></td>
</tr>
<tr>
<td>HDL-cholesterol (mmol/L)</td>
<td>1.16 ± 0.21</td>
<td>1.11 ± 0.28</td>
<td>1.28 ± 0.32</td>
<td></td>
</tr>
<tr>
<td>LDL-cholesterol (mmol/L)</td>
<td>3.67 ± 1.05</td>
<td>3.54 ± 1.00</td>
<td>3.85 ± 0.86</td>
<td></td>
</tr>
<tr>
<td>Triglycerides (mmol/L)</td>
<td>2.09 ± 1.38</td>
<td>2.08 ± 1.3</td>
<td>2.08 ± 1.28</td>
<td></td>
</tr>
<tr>
<td>Fasting plasma glucose (mmol/L)</td>
<td>6.8 ± 3.6</td>
<td>6.8 ± 3.7</td>
<td>6.8 ± 3.6</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>22.97 ± 4.5</td>
<td>22.3 ± 4.5</td>
<td>23.7 ± 4.6</td>
<td></td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>85 ± 12.1</td>
<td>85 ± 11.8</td>
<td>86 ± 12.5</td>
<td></td>
</tr>
<tr>
<td>Waist/hip ratio</td>
<td>0.92 ± 0.10</td>
<td>0.92 ± 0.09</td>
<td>0.92 ± 0.11</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:** CVD = cardiovascular disease; SD = standard deviation; BP = blood pressure; HDL = high-density lipoprotein; LDL = low-density lipoprotein; BMI = body mass index.

**Table 2.** Prevalence of Cardiovascular Risk Factors

<table>
<thead>
<tr>
<th>CVD Risk Parameter</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of hypertension</td>
<td>18.8</td>
</tr>
<tr>
<td>History of diabetes</td>
<td>10.7</td>
</tr>
<tr>
<td>Current smokers</td>
<td>34.9</td>
</tr>
<tr>
<td>History of heart disease</td>
<td>8.3</td>
</tr>
<tr>
<td>BP ≥140/90 mm Hg</td>
<td>52.4</td>
</tr>
<tr>
<td>FPS ≥7 mmol/L</td>
<td>21</td>
</tr>
<tr>
<td>T chol ≥5.2 mmol/L</td>
<td>63.1</td>
</tr>
<tr>
<td>LDL-chol ≥3.4 mmol/L</td>
<td>65.7</td>
</tr>
<tr>
<td>HDL-chol &lt;1.04 mmol/L</td>
<td>36.6</td>
</tr>
</tbody>
</table>

**NOTES:** CVD = cardiovascular disease; BP = blood pressure; FPS = fasting plasma glucose; T chol = total cholesterol; LDL-chol = low-density lipoprotein cholesterol; HDL-chol = high-density lipoprotein cholesterol.
myocardial infarction smoked whereas 26.8% of the controls who did not have any myocardial infarction did so. The smoking rate in our study is nearly as high as that reported in Korea where smoking among men was 61.6% and where their CVD risk was also reported to be high. In contrast, the United States is seeing falling CVD events and falling smoking rates.

Figure 1. Distribution of total Framingham Coronary Heart Disease Risk Prediction Score for men.

Figure 2. Distribution of total Framingham Coronary Heart Disease Risk Prediction Score for women.
rates to 20.8%. In particular, the Framingham Heart Study cohort conducted in the 1970s showed that the rates of smoking even then was lower at 35.2%. The population attributable risk (PAR) associated with smoking is 35.7%. Together with abnormal lipids they account for about two thirds of the PAR of an acute myocardial infarct. The prevalence of abnormal total cholesterol in both men and women in our study population is as high as those seen in men and women older than 45 years in the NHANES III cohort (1988-1994) where about 23% men and 35% women older than 45 years had abnormal total cholesterol. The proportion of our study subjects with low HDL-cholesterol was also similar to the unfavourable CVD risk factors seen in Korea, where 35.1% men had low HDL-cholesterol.

The prevalence of hypertension in those aged 30 years and older in Malaysia is reported to be 32%. The prevalence of hypertension in our study is very high but this is not surprising as this is an older cohort and it is known that BP rises with age. This high prevalence of hypertension, however, is not unusual as many studies have shown a similarly high prevalence among the older age group. This prevalence of hypertension in our study is even higher than in those who had a myocardial infarction in the INTERHEART study where the prevalence of hypertension was 39.0%.

The prevalence of reported and undiagnosed diabetes in this cohort is also high. This is actually consistent with the National Health Morbidity Survey of Malaysia 2006 where diabetes prevalence in adults was reported to be 14.9%. This is in contrast to developed countries, both in the United States and Europe, where prevalence of diabetes is much lower and varies between 6% and 8%. Even in the INTERHEART study, the prevalence of diabetes in the group with myocardial infarction was 18.4% whereas it was much lower in the controls (only 7.5%).

The modest body mass index and waist circumference seen here in the men may suggest a lower CVD risk. However, the waist/hip ratio in men and women, and waist circumference

Table 3. Mean FPS and Predicted 10-Year CHD Risk for Men and Women by Age Group

<table>
<thead>
<tr>
<th></th>
<th>All (N = 1417)</th>
<th>&lt;65 Years (n = 762, 53.8%)</th>
<th>≥65 Years (n = 655, 46.2%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FPS</td>
<td>10-Year Risk (%)</td>
<td>FPS</td>
</tr>
<tr>
<td>Men (n = 757, 53.2%)</td>
<td>9.4</td>
<td>20-25</td>
<td>8.7</td>
</tr>
<tr>
<td>Women (n = 660, 46.6%)</td>
<td>11.4</td>
<td>11-13</td>
<td>11</td>
</tr>
</tbody>
</table>

NOTES: FPS = Framingham CHD risk prediction score; CHD = coronary heart disease.

Figure 3. Distribution of coronary heart disease (CHD) risk categories for men and women by the Framingham 10-year CHD Risk Prediction Score.
in women suggest otherwise. The mean waist circumference of the women is more than the desired value of 80 cm for Asians and suggests abdominal obesity and hence increased CVD risk.\textsuperscript{43,44} The waist/hip ratio for men and women is also higher than the desired ratio of 0.9 for men and 0.85 for women, respectively. Waist/hip ratio $>$0.9 and $>$0.85 for men and women, respectively, has been associated with increased mortality due to CVD and CHD. Waist/hip ratio has also been shown to be a better predictor of CVD and CHD mortality than waist circumference or body mass index.\textsuperscript{45}

No detailed socioeconomic, dietary, or level of physical activity data were collected in this study. How much urbanization or Westernization of diet and other affluence-related factors contribute to this high CVD risk is unknown.

With all these high levels of risk factors it is not surprising that this cohort will carry a high CVD risk. These risk factors account for 5 out of the 9 modifiable risk factors that have been studied and found to contribute a large proportion of the PAR of a myocardial infarction.\textsuperscript{31}

The results of this study are also consistent with the reported medically certified deaths in Malaysia where CVD is the number one cause. This situation may also be similar in other developing countries that have high CVD.

However, although mortality statistics does give an indication of the cause of death, in most emerging economies death certification is usually neither accurate nor complete.\textsuperscript{18} Most of the mortality statistics from developing countries are derived only from medically certified deaths. These in themselves are also subject to flaws and inaccuracies. Many deaths also go unreported or are only certified by lay public like the village head or police-man where the cause of death is commonly assigned to old age or not due to foul play. As such CVD mortality may even be higher than that reported.

There are many different CVD risk prediction scores in current use. Although we take cognizance that the FRS was derived from a predominantly North American Caucasian population and that it is limited to only CHD and not total CVD risk prediction, we prefer to use the FRS for several reasons. First, it predicts both fatal and non-fatal CHD events unlike SCORE, which predicts only fatal CVD events.\textsuperscript{46} Fatality gives a very negative connotation to patients when one is trying to discuss their risk. Furthermore, with SCORE, the risk is deemed to be high if the score is $>$5\% whereas with the FRS high risk is when the risk is $>$20\%. Again this may give a false sense of complacency to the patient when conveyed that his or her risk is high and yet it is only 5\%. Furthermore, SCORE has 2 sets of charts, one for countries with high CVD rates and one for low CVD rates. As the CVD risk in Malaysia has not been described previously and that our aim is to try and ascertain what our CVD risk is, we then have the dilemma of which set of the SCORE chart to use.

Second, although the SCORE prediction chart has the advantage of having more CVD events as it is derived from a much larger number of subjects from many different European countries, the CVD events were based on reports and returns from the different countries and were not validated. With the FRS, the cohort was examined regularly by the investigators themselves and all events were validated by independent experts.

Third, the SCORE prediction chart goes up to age 65 years only whereas the FRS goes up to 74 years. It is important to have a risk score that extends to beyond 65 years because life expectancy of the population worldwide, including Malaysia, is much prolonged. It is precisely in this very age group, that is, in the older individuals, where there is currently insufficient data to guide clinical therapy that a risk score chart that extends beyond 65 years of age is more useful. A total of 46.2\% of the cohort in this study is 65 years or older and hence we will not be able to derive an accurate score for these individuals if charts such as SCORE\textsuperscript{46} or PROCAM\textsuperscript{47} were to be used.
Fourth, the FRS has been extensively validated in different countries and in different ethnic groups, including the Chinese population in China. It was found to be fairly robust but needed some adjustments for use in each individual country. Other risk score charts, such as the QRISK and PROCAM, are again derived from a predominantly Caucasian population in Europe. Although QRISK does include some Asians, they only formed <3% of the database. Furthermore, QRISK included social deprivation in the calculation of CVD risk. This variable is not available in our data set. PROCAM is only applicable for males as it was based on an all-male subjects and again goes only up to age 65 years. Women’s risk using the PROCAM is based on an estimate derived from the score for men rather than derived directly from raw documented data. Choosing anyone of these charts will still not obliterate the fact that they are all still based on a European or North American population and may not be applicable for local use. Because there is no local or regional score charts and for all the reasons outlined above, the choice was to use the FRS chart.

Again the question of why a chart for CHD alone was used instead of one that predicts all CVD is also answered by the same arguments above. PROCAM only predicts CHD events and only in males, and although SCORE covers all CVD events, it has its limitations as outlined above. There is a newly published Framingham Risk Score that is for use in primary care and one which covers all CVD events. However, this chart has not been validated and because it is derived from the same Framingham Heart Study cohort, it does not obliterate the fact that it is still based on a predominantly Caucasian North American population.

A limitation of this study is that the age range of this cohort is narrow and older. Thus, it may be argued that the high prevalence of increased CHD risk as determined by the FRS seen in this study is an overestimation due to the cohort being an older age group. However, older age in itself is associated with increased CVD risk. A study that validated the FRS in the elderly found that it worked well for women but overestimated the risk in men. However, the mean age (70.2 years) of that cohort was older than the participants of this study and hence could have contributed more to the overestimation in that study than our study would have done. Furthermore, the results from our study still show that those younger than 65 years of age were not at much less CVD risk than those aged 65 years or older in both the men and women. Any overestimation if any of CHD risk in our study cohort is probably not very substantial. This is because in this cohort, the prevalence of CVD risk factors is already very high and as such the increased CHD risk seen here may not be due to age alone. Although the high CVD risk may be an accurate reflection of the true risk in this older cohort, it may not represent the true risk of the entire population of Malaysia and so cannot be generalized to the younger age groups.

In terms of the validity of the FRS, a recent study in Malaysia, which looked at the utility of the FRS on 900 clinic patients stratified to low, medium, and high risk, the observed number of CHD events was consistent with that predicted by the FRS. This may suggest that the FRS is robust in predicting CHD risk and hence can be used with some certainty to predict CHD risk in Malaysia.

Finally, this cohort is from a semirural community where CVD risk is generally reported to be lower, but their CVD risk is already very high, suggesting that the urban population might have an even higher CVD risk.

In light of this high prevalence of CVD risk in the community and because it is expected that CVD mortality in developing countries will continue to rise, every effort must be made to lower these risks. A community-based approach will be more appropriate and cost effective. Governmental authorities, including town planners, the food industry, and health care professionals will need to work together to prevent this rising epidemic in developing countries.
Acknowledgments

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References