AN INCREASE IN RISK FACTORS FOR CARDIOVASCULAR DISEASE IN YOGYAKARTA, INDONESIA: A COMPARISON OF TWO CROSS-SECTIONAL SURVEYS

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Abstract. This paper aims to describe changes in risk factors for cardiovascular disease (CVD) over a five year period in urban Indonesia. In 2004 (n=3,205) and 2009 (n=2,467) we conducted cross-sectional surveys of residents in Yogjakarta City, Indonesia evaluating risk factors for CVD. Smoking habits, fruit and vegetable intake, physical activity, blood pressure, weight, and height were recorded. The results of these 2 surveys conducted 5 years apart were then compared. The risk for having a CVD event was also calculated. Behavioral CVD risk factors were more common among men. The predicted risk of having a CVD event increased from 8.4% to 11.3% among men between 2004 and 2009. Effective measures need to be taken to change these behaviors among men in Yogyakarta, Indonesia.

Keywords: non-communicable diseases, chronic diseases, smoking, risk factor, Indonesia

INTRODUCTION

Cardiovascular disease (CVD) is a major cause of morbidity and mortality worldwide. The burden of CVD has especially increased among low and middle income countries (Dhillon et al, 2012; Demaio et al, 2014). Southeast Asia has a higher non-communicable disease (NCD) age-standardized mortality rate, a mortality rate adjusted to the age composition of the population, than the worldwide average (Dhillon et al, 2012; Demaio et al, 2014). Indonesia has also had an increase in CVD morbidity and mortality, especially on urban Java Island (Ala et al, 2010).

The causes of CVD have been studied extensively and so have behavior modification interventions (WHO and WEF, 2011). Prevention and control of CVD is rarely accomplished in Indonesia, where infectious and NCD both cause a public health burden for the country. Health care systems in low and middle income countries are not prepared to manage CVD (Beaglehole and Yach, 2003; Ala et al, 2010) due to a lack of resources and inte-
grated surveillance systems (Daar et al., 2007) capable of monitoring changes in the prevalence of CVD.

One problem in controlling CVD is neglect of CVD by the political agenda (Alleyne et al., 2010). Poor tobacco control in Indonesia is an example of how smoking has been neglected (Thabrany, 2012). To bring CVD to the political agenda, it is necessary to convince decision makers at national and regional levels of its importance, but the number of CVD events in the Indonesian population is unknown. Changes in CVD risk factors over time can provide predictions for future risk of CVD in the population (Bonita et al., 2001).

We studied change in CVD risk factors by comparing two cross-sectional surveys of CVD risk factors (2004 and 2009) conducted in Yogyakarta, Indonesia. Since Yogyakarta has the highest life expectancy in Indonesia (Central Board of Statistics, 2010), it may also see the greatest risk for chronic diseases, such as CVD.

MATERIALS AND METHODS

Study population

This study was conducted in Yogyakarta City, Java, Indonesia. In 2009, the city had 462,752 inhabitants living in 32.5 km² (population density > 14,000 individuals/km²) (Central Board of Statistics, 2010).

To evaluate changes in CVD risk factors we conducted two cross-sectional studies: in 2004 and 2009. The sampling procedure has been described previously (Dewi et al., 2010). Yogyakarta is divided into 1,217 block censuses (BC) by the Central Board of Statistics. Each BC consisted of 80-120 households (Central Board of Statistics, 2010). One hundred fifty BCs were randomly selected and 3,000 subjects aged 15-75 years were asked to participate. The minimum sample size is specified by the WHO STEPs design; we added 30% more subjects to compensate for an estimated non-response rate (WHO, 2005a). A total of 2,467 respondents participated; 1,331 were not interviewed: 138 were unwilling to participate, 136 could not be found and 1,057 were deceased or had moved (Fig 1). An additional 102 subjects were excluded from the study because 71 were physically impaired and 31 were not in the study age range.

Data collection

During both surveys, interviews were conducted at home using a structured STEPwise questionnaire (WHO, 2004). In 2005 the WHO produced a new version of the STEPwise instrument, with some revisions, especially regarding the measurement of physical inactivity (WHO, 2005a). However, we used the 2001 STEPwise instrument for both surveys (WHO, 2004) to ensure comparability.

The STEPwise instrument asked about NCD risk factors. STEP one of the questionnaire asked behavioral questions, STEP two includes physical measurements and STEP three added biochemical assessments. Each STEP had both core and optional parts. The optional parts depend on the resources of the country. STEP three was not included in this study due to financial constraints. Data collection was conducted according to the STEPs field manual guidelines (WHO, 2005b). The questionnaire had previously been translated and validated by a research group in a neighboring province (Ng et al., 2006), and had been tried out on 150 respondents in the 2004 survey.

Demographic variables recorded were age, sex and socioeconomic status (SES) and risk factors recorded were fruit and vegetable intake, tobacco use, physi-
In increasing risk factors of CVD

2004 survey

1,217 BC

150 BC Randomly selected

10-15 households/ BC systematically selected

1-2 individuals/ household selected based on Kish method

3,205 respondents

2009 survey

1,217 BC

150 BC Randomly selected

Excluded from the sampling list

Failed to be interviewed

3,900

3,798

102

1,331

2,467 respondents

BC= Block Census

Fig 1– Sampling procedures for the two study surveys.

cal activity, blood pressure and body-mass index (BMI). To determine the SES, the respondents were asked about their average monthly household income.

Data were collected by trained surveyors. The study was coordinated by two supervisors who checked the validity of the respondents’ answers by re-interviewing five percent of the subjects. The data collection procedure and questionnaires were checked periodically for completeness. The completed questionnaires were delivered to the data manager for data entry and data cleaning.

Data analysis

Data were weighted to match the age and gender distribution of the population in Yogyakarta Municipality in 2004 (Central Board of Statistics, 2005) and 2009 (Central Board of Statistics, 2010) to ensure they were representative of the study group (those aged 15-75 years). Age was defined as the age at interview, and grouped into 20 year intervals since the number of respondents did not meet the minimum sample size when stratified into ten year age groups. The SES was categorized into low or high based on the median, low being a monthly household income of ≤600,000 rupiahs in 2004 and 1,000,000 rupiahs in 2009 and high being above those respective medians. Low fruit and vegetable intake was defined as consumption of <4.5 portions per day (Joint WHO and FAO, 2002). Smoking was defined as smoking at least one cigarette per day (WHO, 2005b).

Physical activity was divided into 3 types: work, leisure and transportation. Respondents were classified as working vigorous if their work required them to do heavy lifting, digging or constructions, and moderate if they had to walk briskly or carry light loads for at least 10 minutes at a time on a typical work day. Respondents were classified as having vigorous leisure activity if they exercised by running and moderate if they walked or swam for at least 10 minutes at a time on a typical day. Transportation activity was described as moderate if they walked or rode a bicycle for at least 10 minutes at a time on a typical day (WHO, 2005b). Physical activity was defined as low if the weekly average for vigorous and moderate physical activity was <105 minutes.

Respondents were defined as having elevated blood pressure if their systolic
blood pressure was ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or if they took antihypertensive medication (WHO, 2005b). BMI was calculated as the weight in kg divided by the height in meters squared. Respondents were categorized as being under weight (BMI<18.5), normal weight (BMI=18.5-22.9), overweight (BMI=23-24.99) and obese (BMI≥ 25 kg/m²) (WHO Expert consultation, 2004).

Predicted CVD risk, both fatal and non-fatal, within the next five years was calculated using a chart developed by Gaziano et al (2008) derived from the WHO/ISH risk prediction chart (WHO, 2007) and adapted to suit low and middle income countries. The risk was predicted based on sex, age, systolic blood pressure, smoking status, blood pressure treatment status, history of diabetes mellitus and BMI. Respondents were classified as being at high risk for CVD if their five year risk was greater than 20% (Mendis et al, 2007).

The chi-square test was used to evaluate differences in risk factor prevalence between 2004 and 2009. Significance was set at \( p<0.05 \). Data were analyzed using STATA, version 11 (StataCorp LP, College Station, TX).

**Ethical consideration**

Ethical clearance for this study was obtained from the ethics committee of the Faculty of Medicine, Gadjah Mada University. Official permission to conduct the study was obtained from the Government of Yogyakarta Municipality. Before participation, written informed consent was obtained from each respondent.

**RESULTS**

A summary of the respondents’ characteristics, lifestyles and physical measurements during the first and second surveys is shown in Table 1. The demographics during the two surveys were similar. However, the prevalence of low fruits and vegetable intake increased significantly \( (p=0.008) \) from 2004 (81%) to 2009 (85%). Physical inactivity during leisure increased significantly from 15% (2004) to 23% (2009) with a \( p \)-value=0.000. Similarly, physical inactivity during transportation also increased significantly from 64% in 2004 to 73% (2009) \( (p=0.000) \). The average BMI in 2004 was 23.0 and in 2009, 23.2; the difference was significant \( (p=0.045) \) and the mean diastolic blood pressure also increased significantly \( (p=0.001) \) from 80 mmHg (2004) to 81 mmHg (2009).

The mean diastolic blood pressure increased significantly with a \( p \)-value of 0.001 (Table 1) as did the prevalence of elevated blood pressure among men aged ≥60 years from low SES (56% to 73%, \( p=0.012 \)) and from high SES (59% to 73%, \( p=0.018, \) Table 2). The mean BMI increased significantly from 23.0 kg/m² to 23.2 kg/m² \( (p=0.045, \) Table 1) and so the proportion of overweight among men aged 60-75 years from a higher SES (23% to 35%, \( p=0.040, \) Table 2). The prevalence of daily smoking was still common among men, but did decrease significantly from 2004 (60%) to 2009 (54% \( p=0.0234 \)) (Fig 2). However, this decrease was only seen among young men from a higher SES (57% to 47%, \( p=0.0345 \)) and very old men both from low SES (61% to 37%, \( p=0.002 \)) and high SES from 50% to 24% \( (p=0.000) \) (Table 2). In 2004 to 2009, respondents with lower fruit and vegetable intakes increased from 81% to 85% \( p=0.008, \) Table 1), especially among men (82% to 86%, \( p=0.022 \)) (Fig 2). Fewer people were working vigorously or had moderate levels of activity (32% to 23%, \( p<0.000 \)) in 2009 than in 2004 (Table 1), further analysis showed that physically inactive increased among men, aged 50-59 years from a lower
**Table 1**

Characteristics of respondents by survey year.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>2004 (N=3,205)</th>
<th>2009 (N=2,467)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>48</td>
<td>49</td>
<td>0.380</td>
</tr>
<tr>
<td>Women (%)</td>
<td>52</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Age in years (X ± SD)</td>
<td>34 ± 15.3</td>
<td>34 ± 15.2</td>
<td>0.530</td>
</tr>
<tr>
<td>Length of education in years (X ± SD)</td>
<td>11 ± 4.1</td>
<td>11 ± 3.7</td>
<td>0.098</td>
</tr>
<tr>
<td><strong>Lifestyle</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking (%)</td>
<td>30</td>
<td>27</td>
<td>0.063</td>
</tr>
<tr>
<td>Low fruit and vegetable intake (%)</td>
<td>81</td>
<td>85</td>
<td>0.008*</td>
</tr>
<tr>
<td>Physical activity levels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical inactivity (%)</td>
<td>36</td>
<td>38</td>
<td>0.429</td>
</tr>
<tr>
<td>Working–vigorous and moderate (%)</td>
<td>32</td>
<td>23</td>
<td>0.000*</td>
</tr>
<tr>
<td>Leisure–vigorous and moderate (%)</td>
<td>15</td>
<td>23</td>
<td>0.000*</td>
</tr>
<tr>
<td>Transportation–moderate activity (%)</td>
<td>64</td>
<td>73</td>
<td>0.000*</td>
</tr>
<tr>
<td><strong>Physical measurements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>128.4 ± 22.7</td>
<td>129.2 ± 22.6</td>
<td>0.104</td>
</tr>
<tr>
<td>Diastolic blood pressure</td>
<td>80 ± 12.4</td>
<td>81 ± 11.8</td>
<td>0.001*</td>
</tr>
<tr>
<td>Elevated blood pressure (%)</td>
<td>23</td>
<td>22</td>
<td>0.178</td>
</tr>
<tr>
<td>Body mass index</td>
<td>23.0 ± 4.5</td>
<td>23.2 ± 4.7</td>
<td>0.045*</td>
</tr>
<tr>
<td>Body mass index category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight (%)</td>
<td>18</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Normoweight (%)</td>
<td>44</td>
<td>42</td>
<td>0.204</td>
</tr>
<tr>
<td>Overweight (%)</td>
<td>13</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Obese (%)</td>
<td>25</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

* Significant at p<0.05

SES (18% to 39%, p=0.002) and among women, aged 15-49 years from a lower SES (31% to 44%, p=0.001; Table 2).

The percentage of those at high risk of getting CVD within the next five years increased significantly (p=0.004) from 6.9% in 2004 to 8.3% in 2009 (Fig 3). The percentage of those at high risk for CVD increased significantly among men from both a low and high SES (8.4% in 2004 to 11.3% in 2009, p=0.000), but decreased insignificantly among women (5.5% to 5.4%, p=0.898 (Fig 3).

In 2004, more men had a high risk of CVD at 50-59 years than woman (24% compared to 9%, Fig 4). The proportion of men aged 50-59 years at high risk for CVD increased significantly from 24% to 36% (p=0.000) between 2004 and 2009 and the proportion of women decreased insignificantly from 9% to 8% (p=0.585) during the same time period.

**DISCUSSION**

The purpose of this study was to describe the change in CVD risk factors over a five year period in Yogyakarta, Indone-
The prevalence of some behavioral risk factors increased over the five year study period, especially among men. Cardiovascular disease risk was higher and started at an earlier age among men than women. Both physical risk factors for CVD (elevated blood pressure and overweight/obesity) and lifestyle risk factors (smoking, physical inactivity and low fruit and vegetable consumption) were common in the study population. Men in some age and SES groups had more risk factors. One benefit was that few women smoked.

In our study the prevalence of smoking remained relatively unchanged over the 5 year study period, similar to an Indonesian national survey where the prevalences of smoking in 2007 and 2010 were 34.2% and 34.7%, respectively (Board of Research and Development, 2007; 2010). The prevalences of smoking in our study were high among men but low among women (54.1% and 0.82%) similar to a study from Purworejo, a district in neighboring province of Indonesia (62.7% and 1.4%) (Ahmed et al., 2009).

The prevalence of low fruit and vegetable intake was high among both men and women in our study in 2004 (81%) and in 2009 (85%), similar to an Indonesian national survey in 2007 (86.1%) (Board of Research and Development in Health, 2007). The prevalence of low fruit and vegetable intake was high among both men and women in our study (85.8% and 83.6%), but lower than a study from Purworejo, Indonesia (93.4% and 89.5% for men and women) (Ahmed et al., 2009). Low consumptions of fruits and vegetables were more common (81% and 85% in 2004 and 2009), especially in those from a low SES group. Barber et al (2008) found among low SES subjects, the expenditure on cigarettes and on food was equal (both 11% of the total expenditure) (Barber et al., 2008). Improving subject knowledge about healthy food could encourage them...
Table 2  
Cardiovascular disease risk factors by age during both study surveys.

<table>
<thead>
<tr>
<th>Risk factors and socioeconomic status (SES)</th>
<th>Percent prevalence among age groups after weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoker</td>
<td>64 65</td>
</tr>
<tr>
<td>SES low</td>
<td>57 47</td>
</tr>
<tr>
<td>SES high</td>
<td>58 51</td>
</tr>
<tr>
<td>Low fruit and vegetable intake</td>
<td>85 85</td>
</tr>
<tr>
<td>SES low</td>
<td>79 81</td>
</tr>
<tr>
<td>SES high</td>
<td>78 81</td>
</tr>
<tr>
<td>Physical inactivity</td>
<td>35 40</td>
</tr>
<tr>
<td>SES low</td>
<td>37 37</td>
</tr>
<tr>
<td>SES high</td>
<td>31 28</td>
</tr>
<tr>
<td>Elevated blood pressure</td>
<td>22 14 *</td>
</tr>
<tr>
<td>SES low</td>
<td>23 17</td>
</tr>
<tr>
<td>SES high</td>
<td>24 50</td>
</tr>
<tr>
<td>Overweight and obese</td>
<td>16 16</td>
</tr>
<tr>
<td>SES low</td>
<td>27 28</td>
</tr>
<tr>
<td>SES high</td>
<td>28 46</td>
</tr>
</tbody>
</table>

* Significant at $p<0.05$.

to make better choices for household resource allocations.

Over the five year study period, although leisure and transportation activities increased (15% to 23%) and (64% to 73%), but those activities decreased in the low SES group (data not shown). Estabrook et al (2003) found people of low SES tended to live in a neighborhood with limited facilities for physical activity. The prevalences of physical inactivity was high among both men and women (34.6% and 40.7%), higher than in a study from Purworejo (12.3% and 25.6%) (Ahmed et al, 2009).
Although the mean of diastolic blood pressure increased during the study period, the prevalences of elevated blood pressure in 2004 and 2009 did not change significantly (23% and 22%, respectively) and was lower than Indonesian national survey in 2007 (35.8%) (Board of Research and Development in Health, 2007). More men suffered from elevated blood pressure (25.2%) than women (18.4%), unlike a study from Purworejo where both men (24.1%) and women (24%) had similar percentages (Ahmed et al, 2009). Smoking is a risk factor for hypertension (Venkataraman et al, 2013), and smoking is common in Indonesia among men. The deaths due to smoking related diseases are expected to increase for another 40 years because Indonesia may be in the second phase of a tobacco epidemic (Lopez et al, 1994).

BMI increased significantly (23.0% to 23.2%) during the five year study period. The prevalence of overweight and obesity was higher among women (29.6%) than men (22.5%) in our study and higher than a survey in Yogyakarta Province (18.7%) (Board of Research and Development, 2010) and higher than a study from Purworejo (24.6% among women and 10% among man) (Ahmed et al, 2009). The increase in the mean BMI in our study suggests a problem of overweight and obesity in
the future in this study population. This increasing BMI may be related to less consumption of fruit and vegetables, and less vigorous and moderate physical activity. Although the overall prevalence of overweight and obesity was higher among women, the greatest increase in prevalence over the 5 year study period was among men, aged 50-75 years from the high SES group.

WHO guidelines recommend modifying behavioral risk factors, such as factors influencing blood pressure, blood glucose, lipids, and weight/obesity (WHO, 2005b) by mobilizing multiple sectors at the national level (Bonita et al., 2013).

Population wide strategies and high-risk individual strategies need to be combined. High-risk individual strategies treat a smaller number of people at highest risk for CVD, resulting in the greatest benefit to the individual and the public health as a whole (Ahern et al., 2008).

CVD risk factors are more prevalent among the poor and proximate risk factors are more prevalent among the rich (Kinra et al., 2010). Our findings in Yogyakarta, Indonesia suggest a potential future increase in CVD among the poor in this region.

The prevalences of elevated blood pressure (one fifth of adults studied), and overweight/obesity (one third of adults studied) indicates future chronic disease problems and should be regarded as a serious public health challenge for Indonesia. Singapore’s National Healthy Lifestyle Program conducted since 1992, has seen a decline in CVD mortality (Bhalla et al., 2006), indicating a successfully launched health promotion program can result in long term benefits. Therefore, it is important to start taking action now in Yogyakarta.

Smoking and hypertension need to be controlled. The Framework Convention on Tobacco Control (FCTC) should be ratified by Indonesia. Promoting salt reduction to control blood pressure (He and MacGregor, 2004) also needs to be promoted in Indonesia to reduce CVD risk.

There were several limitations in this study. Different sampling methods were used between 2004 and 2009. In 2004, due to financial constraints, the only available sampling frame was the list of BCs. According to the WHO (2005b), the Kish sampling method should be used to select individuals who fulfill age and sex criteria. In each BC, whenever the minimum sample size for each 10 year age-group for sex did not meet the criteria, substitutional respondents from adjacent households were selected. This method may have possibly biased the results depending on whether the respondents being replaced had fewer or more CVD risk factors. However, there were no differences in demographic characteristics among the substituted respondents (Dewi et al., 2010).

We found an increase in the prevalence of CVD risk factors in urban Yogyakarta, Indonesia. Even if an immediate comprehensive CVD risk intervention was initiated today, the problem of CVD would continue to increase for years before it would improve. Therefore a comprehensive, long term CVD risk interventions program should be initiated immediately and should include a focus on tobacco control. It should involve multiple stakeholders from multiple sectors.

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