Complications from hypertension cause 9.4 million deaths in the world population each year. Hypertension is responsible for 45% of deaths due to heart disease and 51% of deaths from stroke (1). In 2013, the Indonesian Ministry of Health reported that there have been changes in the epidemiology and demographics that led to the increased number of deaths from non-communicable diseases. This is expected to continue as evidenced by the considerably high rate of the national prevalence of hypertension at 26.5% for the population over 18 y based on the results of blood-pressure measurements (2). In addition, the results of a study on primary health in 2007 by the Indonesian Ministry of Health showed that hypertension ranks third as the cause of death in the Indonesian population at all ages with a percentage of 6.8%, and became the second most common non-communicable disease at all ages, with a percentage of 12.3% (3).

Hypertension is a disease that has no specific symptoms, and which is triggered by high blood pressure in the arteries that causes an increased risk of stroke, aneurysm or dilation of blood vessels, heart failure, heart attack and kidney damage. This is why it is called “the silent killer” (4). Various epidemiological studies indicate that hypertension is the result of a complex interaction between genetic and environmental factors, including high intake of salt, alcohol, and obesity. Moreover, hypertension is also affected by increasing age and stress, as well as lack of physical activity (5). Based on research, passive smoking is also associated with hypertension (6).

The high percentage of cases of hypertension in women aged over 50 y may be due to hormonal changes that occur after menopause. It causes the protection against damage to blood vessels to decrease, and the consequence is increased risk of hypertension and other vascular diseases. Antioxidant precursors, such as selenium, however, are known to provide protection against the development of several oxidative stress-related diseases, including hypertension. To prove the hypothesis, we compared the levels of consumption of selenium in hypertensive and normotensive post-menopausal women. An observational comparative study with cross-sectional design was conducted in groups of post-menopausal women with hypertension and those who are normotensive. Structured interviews and food recall of 2×24 h were used to determine the level of consumption, and the Depression, Anxiety and Stress Scale (DASS) questionnaire was used to measure the level of stress. The result suggests a significant difference in the levels of selenium intake between the normotensive and hypertensive groups ($p=0.008$). Furthermore, the passive smoking and stress levels of the hypertensive group were significantly higher than those of the normotensive group. These result support the hypothesis that selenium may play a protective role in vascular disease.

**Materials and Methods**

This is an observational comparative study with a cross-sectional design. Factors that cause hypertension are easier to find in urban areas, so the researcher chose the city of Surabaya, the capital of East Java Province as a place of study. The study location is in the district of Mulyorejo because it was the district with the highest number of patients with hypertension in 2011 and 2012. The study population was composed of post-menopausal women aged 45–64 y who came to the
Table 1. General characteristics of participants.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Normotensive (n=13)</th>
<th>Hypertensive (n=13)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>54</td>
<td>56</td>
<td>0.4761</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>6</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Blood pressure (mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>118±12</td>
<td>155±17</td>
<td>p&lt;0.051</td>
</tr>
<tr>
<td>Diastolic</td>
<td>75±8</td>
<td>100±14</td>
<td>p&lt;0.051</td>
</tr>
</tbody>
</table>

1 Independent t-test.

Table 2. Levels of selenium consumption of participants.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Normotensive (n=13)</th>
<th>Hypertensive (n=13)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selenium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>7</td>
<td>54</td>
<td>11</td>
</tr>
<tr>
<td>Sufficient</td>
<td>6</td>
<td>46</td>
<td>2</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean (µg)</td>
<td>53±18</td>
<td>33±17</td>
<td>0.0081,*</td>
</tr>
</tbody>
</table>

1 Independent t-test.
* Significant (p<0.05).

DASS, there were several stress classifications: normal (grades 0–14), mild (grades 15–18), moderate (grades 19–25), severe (grades 26–33) and extremely severe (grades ≥34) (12). Furthermore, body mass index (BMI) of the patients was also calculated and divided into universal cut-off values: underweight (BMI <18.5 kg/m²), normal (BMI 18.5–25 kg/m²), overweight (BMI 25.1–30 kg/m²), and obese (BMI ≥30 kg/m²) (13).

Patients with other disease complications or in therapy with medicines that may affect blood pressure were excluded from the study. This study complied with the code of ethics of the World Medical Association’s Declaration of Helsinki, and was approved by The Health Research Ethics Committee of the Faculty of Public Health, Airlangga University. All the participants included in this study agreed to participate by completing a written informed consent form.

RESULTS

General characteristics of the participants

The mean age of the study subjects in the normotensive group was 54 y, while in hypertensive group, the mean age of the subject was 56 y. There were significant differences in the systolic and diastolic blood pressures between the normotensive and hypertensive groups (p<0.05) (Table 1).

Levels of selenium consumption

There was a significant difference in the levels of selenium intake between the normotensive and hypertensive groups (p=0.008) (Table 2). The level of selenium consumption in the normotensive group was higher than that of the hypertensive group. Most of the levels of selenium consumption in the hypertensive group (85%) and normotensive group (54%) were in the ‘low’ category. Two participants (15%) from the hypertensive group and 6 participants (46%) from the normotensive group were classified under the ‘sufficient’ category.
Lifestyle

Four patients (31%) in the normotensive group were passive smokers, while there were 10 such participants (77%) in the hypertensive group. The number of passive smokers in the hypertensive group was higher than that in the normotensive group ($p=0.049$) (Table 3).

Physical activity was measured according to the WHO recommendations that stated physical activity or exercise at least 30 min a day and five times a week (1). Two participants (15%) from the normotensive group were known to do physical activity as recommended by the WHO, while in the hypertensive group, no patients (0%) did any physical activity as recommended by the WHO. The difference, however, was not significant ($p=0.48$) (Table 3).

Based on the results of the DASS questionnaire, there were significant differences in stress levels between the normotensive and hypertensive groups ($p=0.017$) (Table 3). In the normotensive group, 10 participants were identified as normal, and 3 were identified as having mild stress. In the hypertensive group, 5 participants were identified as normal, 2 participants with mild stress, 2 participants with moderate stress and 2 participants with severe stress.

DISCUSSION

Selenium is one of the antioxidant nutrients that support the immune system, providing protection against the risk of cancer; it serves as one of the supporting factors of fertility; and is also needed by the body to produce prostaglandins, which are substances that can affect blood pressure (14). In this study, we show that the daily intake of selenium is associated with the decreased risk of hypertension. The results are in agreement with a previous report from the National Health and Nutrition Examination Survey (NHANES III) which states that the decrease in serum selenium may be a risk factor for hypertension (15).

Normally, there is a balance between the formation and destruction of radicals. However, in an oxidative stress condition where exposure to free radicals exceeds the protective capacity of the antioxidant defense system, damage to molecules can occur and cause diseases. Selenium is an integral part of the glutathione peroxidase (GSHPx) enzyme that acts as part of the body’s defense mechanism to protect important molecules (lipid and DNA) and the cell membrane against the impact of damage by free radicals (16). A study from India reported that oxidative stress plays an important role in the pathogenesis of hypertension, as in their human studies, hypertension is accompanied by increased oxidative stress (17).

Our result also shows a significant number of passive smokers in the hypertensive group, compared with those in the normotensive group. A study in Iran reported that systolic and diastolic blood pressures were higher in elementary school children who were exposed to cigarette smoke compared with those who were not exposed (18). This result is also supported by the results of a study in San Francisco which proves that the effects of passive smoking are often nearly 80–90% as large as chronic active smoking, including increased atherosclerosis, increased oxidative stress, decreased antioxidant defense and others that may affect blood pressure and increase the risk of heart disease (19).

Active smokers only inhale about 15% of the smoke from a cigarette while the rest returns to the environment and is inhaled by passive smokers; thus passive smokers are exposed to greater carcinogenic toxins and poisons than active smokers are. Furthermore, there are also toxins from tobacco smoke that are formed at lower temperatures and release even larger amounts of harmful substances.

When stress occurs, the receptor sends signals to the brain to release the hormone epinephrine or adrenaline into the bloodstream. This hormone can affect the functioning of the heart and blood vessels, and increases blood pressure on a regular basis (20). Our results suggest significant differences in the stress level as mild, moderate and severe between the normotensive and hypertensive groups. These results are in agreement with a previous report that states that in women aged 45–64 y, a number of psychosocial factors such as state of tension, marital incompatibility, economic pressure, daily stress, job mobility and pent-up anger are known to be associated with increased blood pressure and clinical manifestations of any cardiovascular disease (21). In addition, a case study in Japan states that the ability to manage stress is an important factor to control blood pressure. Uncontrolled stress in hypertensive patients may lead to life-threatening effects and resistance to drug therapy (22).

This study, however, is not without limitations. In this study, we did not measure the blood selenium concentration of the patients; thus, we could not analyze the association of its intake and blood concentration to the blood pressure of the patients. Furthermore, we also did not measure the lipid profiles of the patients, which may also affect the blood pressure.

In conclusion, our results suggest differences in selenium intake, stress level, and effect of passive smoking between the normotensive and hypertensive groups. Although further study is needed, this study supports the hypothesis that selenium may play a role in hypertension.

REFERENCES


