Lifestyle-related Factors Which Affect Blood Pressure Components in Outpatients with Hypertensive Status: A Hospital-based Study

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BACKGROUND: An effective approach to lifestyle-related factors could be a main treatment for hypertensives. The components of blood pressure (BP) have been reported to have different clinical implications; however, the relationship between various lifestyle-related factors and BP components has not been thoroughly studied in hospital-based general medicine.

METHODS: This relationship was cross-sectionally investigated in a population of outpatients with hypertension but free of other diseases (136 subjects, aged 30 to 75, mean 54.2 years). A self-administered questionnaire, which included items related to demographics, smoking, alcohol use, affinity for salt, habitual exercise, and sleep status, was used.

RESULTS: After controlling for lifestyle-related factors, multiple regression analysis revealed that body mass index (BMI) and smoking were significantly and positively correlated with systolic BP (SBP) and pulse pressure (PP). For diastolic BP (DBP), age had a significantly negative, and lack of sleep had a significantly positive, correlation. BMI was also significantly and positively correlated with mean BP (MBP).

CONCLUSIONS: Our results suggest that lifestyle-related factors are associated with differing BP components. Weight control should receive more attention in SBP, MBP and PP control, anti-smoking in SBP and PP control, and sleep management in DBP control.

KEY WORDS: lifestyle, BMI, smoking, sleep

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Diastolic blood pressure (DBP) has previously been considered the most important component of blood pressure (BP).1 Recently, increases in both systolic blood pressure (SBP) and DBP have been used in classifying cardiovascular risks.2 Also, increased SBP, pulse pressure (PP), and mean
blood pressure (MBP) have been studied individually to find out whether they could be a determinant of cardiovascular risk. More recently, PP has been especially recognized as a predictor of cardiovascular diseases. In this way, each of the components of BP has a different clinical significance.

Various lifestyle-related factors affect BP levels, such as age, obesity, smoking, alcohol use, high salt intake, and exercise. These lifestyle-related factors have been found to be strongly related to high BP, so an understanding of the relationship between lifestyle-related factors and BP components is an important issue for strategies to control BP and in turn to combat cardiovascular disease. Recently, sleep loss has also been noted as a lifestyle-related factor tied to increased BP and cardiovascular disease, though a detailed mechanism has not yet been uncovered. Available data about lifestyle-related factors in relation to BP components are sparse.

Outpatient practice in general medicine is one of the most effective settings for general lifestyle management. Thus, we conducted a cross-sectional study to examine the association between lifestyle-related factors and BP components in hypertensive subjects in the setting of outpatient rooms in hospital-based general medicine.

SUBJECTS AND METHODS

Between 2001 and 2005, a total of 136 subjects (male : female = 90 : 46), aged 30 to 75 (mean age of 54.2 ± 8.7 (SD)) years, were recruited from a population of consecutive outpatients who were visiting our hospital’s divisions of general medicine for the first time. In the recruitment, patients with acute diseases (e.g., common cold) were excluded, and those whose chief complaints were unrelated to acute diseases (e.g., requests for re-assessment or further examination after a general health check-up) were included. All of the patients that we questioned were included in the present study. Our hospitals are general hospitals with more than 100 beds.

Prior to the first visit, none of these subjects had a past history of chronic diseases such as cardiovascular and metabolic diseases, nor were they taking any medication known to influence BP. In all subjects, physical examination, routine blood tests (concerning hepato-renal function, glucose and lipids) and urine tests returned values within reference ranges. Body mass index (BMI) was calculated as weight (kg)/height (m)^2. Weight and height measurements were taken in light clothing without shoes. After 5 minutes of rest, physicians measured the sitting BP of each individual 3 times in the right upper arm with a standard mercury sphygmomanometer. SBP levels of 140 mmHg or higher and/or DBP levels of 90 mmHg or higher in all 3 measurements were classified as hypertension. The mean of all 3 values was used as a measure of BP in this study. MBP was calculated as DBP + (SBP - DBP) / 3. PP was calculated as SBP - DBP.

Lifestyle-related data were based on self-reports given in reply to a questionnaire that was designed to be as simple and effective as possible at getting the required information (Table 1). As in previous research, smokers were defined as current smokers. Ex- and never-smokers were combined into the no-smoking group. Similarly, an alcohol habit was defined as more than 3 days/week (regardless of type or amount of alcohol). We think that few patients were ex-drinkers due to the fact that our study patients had no history of chronic diseases. A positive affinity for salt was also assessed. Habitual exercise was defined as walking more than 30 min/time, 2 times/week or the equivalent, with reference to the National Nutrition Survey. Patients were asked to rate their sleep status by choosing one of the following 3 categories: “good”; “sometimes lacking”; “always lacking”; this question has been assessed in a primary care setting.

The study was designed according to the Declaration of Helsinki, and all data were treated anonymously.

The results were expressed as mean ± standard deviation (SD). Simple relationships between the variables were analyzed using Spearman’s rank correlation. The relationships between BP levels of respective components and lifestyle-related factors, such as gender, age,
Table 2. Correlation coefficients for blood pressure components and lifestyle-related factors

<table>
<thead>
<tr>
<th></th>
<th>SBP</th>
<th>DBP</th>
<th>MBP</th>
<th>PP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, male</td>
<td>0.091 (0.290)</td>
<td>0.266 (0.002**)</td>
<td>0.231 (0.007**)</td>
<td>−0.069 (0.421)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>0.251 (0.003**)</td>
<td>−0.326 (0.0001*** )</td>
<td>−0.126 (0.143)</td>
<td>0.378 (&lt;0.001*** )</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>0.265 (0.002**)</td>
<td>0.101 (0.241)</td>
<td>0.246 (0.004**)</td>
<td>0.200 (&lt;0.05*)</td>
</tr>
<tr>
<td>Smoking, current smokinga</td>
<td>0.150 (0.082)</td>
<td>0.070 (0.417)</td>
<td>0.118 (0.174)</td>
<td>0.087 (0.315)</td>
</tr>
<tr>
<td>Alcohol, habitb</td>
<td>0.026 (0.764)</td>
<td>0.227 (0.009**)</td>
<td>0.124 (0.158)</td>
<td>−0.080 (0.361)</td>
</tr>
<tr>
<td>Affinity for saltc</td>
<td>0.006 (0.948)</td>
<td>−0.019 (0.828)</td>
<td>−0.038 (0.660)</td>
<td>0.001 (0.986)</td>
</tr>
<tr>
<td>Exercise, no habitd</td>
<td>0.050 (0.572)</td>
<td>0.146 (0.097)</td>
<td>0.165 (0.061)</td>
<td>−0.046 (0.605)</td>
</tr>
<tr>
<td>Sleep status e</td>
<td>0.109 (0.205)</td>
<td>0.132 (0.124)</td>
<td>0.132 (0.125)</td>
<td>0.056 (0.517)</td>
</tr>
</tbody>
</table>

Correlation coefficients are by Spearman's rank correlation. Parentheses express P values. SBP, systolic blood pressure; DBP, diastolic blood pressure; MBP, mean blood pressure; PP, pulse pressure. The presence/absence of smoking, alcohol use, affinity for salt and habitual exercise were evaluated as follows: a Smokers were defined as current smokers; b Alcohol habit was defined as more than 3 days/week; c Affinity for salt was defined as a positive preference for food seasoned with salt; d Habitual exercise was defined as walking more than 30 min/time in 2 times/week or the equivalent. e Sleep status used an additive model (good=1, sometimes lacking=2, always lacking=3). Significance value: *P<0.05, **P<0.01, ***P<0.001.

Table 3. Regression coefficients for blood pressure components (dependent variable) and biosocial factors (independent variables)

<table>
<thead>
<tr>
<th></th>
<th>SBP</th>
<th>DBP</th>
<th>MBP</th>
<th>PP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, male</td>
<td>−0.011 (0.914)</td>
<td>0.183 (0.054)</td>
<td>0.123 (0.212)</td>
<td>−0.122 (0.186)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>0.224 (0.012*)</td>
<td>−0.355 (0.0001*** )</td>
<td>−0.127 (0.155)</td>
<td>0.432 (0.0001*** )</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>0.352 (0.0001*** )</td>
<td>0.054 (0.517)</td>
<td>0.233 (0.008** )</td>
<td>0.304 (0.0001*** )</td>
</tr>
<tr>
<td>Smoking, current smokinga</td>
<td>0.229 (0.015*)</td>
<td>−0.098 (0.281)</td>
<td>0.057 (0.544)</td>
<td>0.279 (0.002**)</td>
</tr>
<tr>
<td>Alcohol, habitb</td>
<td>−0.072 (0.442)</td>
<td>0.122 (0.183)</td>
<td>0.046 (0.630)</td>
<td>−0.144 (0.107)</td>
</tr>
<tr>
<td>Affinity for saltc</td>
<td>−0.026 (0.760)</td>
<td>0.020 (0.815)</td>
<td>−0.001 (0.993)</td>
<td>−0.037 (0.648)</td>
</tr>
<tr>
<td>Exercise, no habitd</td>
<td>0.055 (0.530)</td>
<td>0.091 (0.284)</td>
<td>0.095 (0.286)</td>
<td>−0.003 (0.970)</td>
</tr>
<tr>
<td>Sleep status e</td>
<td>0.036 (0.674)</td>
<td>0.185 (0.026*)</td>
<td>0.150 (0.082)</td>
<td>−0.079 (0.324)</td>
</tr>
</tbody>
</table>

Regression coefficients are by multiple regression analysis. Parentheses express P values. SBP, systolic blood pressure; DBP, diastolic blood pressure; MBP, mean blood pressure; PP, pulse pressure. The presence/absence of smoking, alcohol use, affinity for salt and habitual exercise were evaluated as follows: a Smokers were defined as current smokers; b Alcohol habit was defined as more than 3 days/week; c Affinity for salt was defined as a positive preference for food seasoned with salt; d Habitual exercise was defined as walking more than 30 min/time in 2 times/week or the equivalent. e Sleep status used an additive model (good=1, sometimes lacking=2, always lacking=3). Significance value: *P<0.05, **P<0.01, ***P<0.001.

BMI, smoking, alcohol use, affinity for salt, habitual exercise, and sleep status, were tested using multiple regression analysis. Differences were considered statistically significant if the P values were <0.05.

RESULTS

The mean SBP, DBP, MBP and PP values were 148.1±17.0, 94.6±10.0, 112.4±10.2 and 94.6±10.8 mmHg, respectively. The mean BMI value was 24.0±3.0 kg/m². In these results, gender differences were not observed. The results by Spearman’s rank correlation are illustrated in Table 2. In SBP and PP, age and BMI were significantly and positively correlated factors. In DBP, male gender and alcohol habits were significantly and positively correlated factors, but in contrast, age had a significantly negative correlation. In MBP, male gender and BMI were significantly and positively correlated factors. The results using multiple regression analysis are presented in Table 3. In SBP and PP, age, BMI and current smoking status were significantly and positively correlated factors. In DBP, lack of sleep was a significantly and positively correlated factor, but, to the contrary, age was a significantly and negatively correlated factor. In MBP, only BMI had a significantly positive correlation.
DISCUSSION

The strength of our study is that lifestyle-related factors, which are important non-biochemical measures in general practice to view hypertensive patients as a whole, are simultaneously investigated in relation to BP components. This study found the presence of different lifestyle-related factors correlated to the respective BP components. For instance, we sometimes see hypertensive patients with elevated levels of only one component (e.g., DBP or SBP). In such a case, our findings might be useful to manage BP levels in particular.

In general, the prevalence of hypertension is greater in males than in females. However, there have been few reports showing gender-differences in the levels of the respective BP components, although one study has reported that gender is related to SBP. In our study, males displayed higher levels of DBP and MBP. The correlations of DBP and MBP with gender were less significant by multiple regression analysis, and therefore may be related to confounding factors.

Age causes increased BP and contributes to developing hypertension. A positive correlation of SBP and PP with age was found, and a negative correlation with age was found specifically in DBP. In the pathophysiology of the aging process, increased SBP and PP or decreased DBP have been reported, and our results might be accounted for by the aging process as well.

In a number of studies, BMI was found to be a strongly significant factor for increased BP and hypertension. A previous study has reported that BMI is related to DBP. From our results, BMI was a significant risk factor common to BP components except for DBP. The reason for differences between these results was unclear, but was, in part, likely due to study populations and settings.

As for smoking, one study has documented lower BP in smokers than in non- and ex-smokers, and found SBP inversely affected by smoking. Several other studies also found a negative correlation between smoking and hypertension. On the other hand, adverse effects of smoking on BP and hypertension were also found. In our multiple regression analyses, current smoking habits were found to be positive correlated factors with both SBP and PP, and our results support findings of adverse effects of smoking. Taking into account the fact that more smokers have cardiovascular events than nonsmokers, even if smoking sometimes lowers BP, we can not ignore the adverse effects on SBP and PP.

A positive relationship between alcohol consumption and BP or hypertension has been reported in several studies. A positive relationship between habitual alcohol consumption and DBP was seen in a single regression analysis of our data, but was not seen in multiple regression analysis. Even if alcohol habits affect BP levels, particularly DBP, the association did not seem clinically strong in our study population.

High salt intake has been shown to be mainly related to increased BP or hypertension. Our study failed to show significant relationships between an affinity for salt and any BP component. Although it is assumed that a preference for salty foods and salt intake are correlated, we are not certain to what degree an affinity for salt represents actual salt intake. The influence of salt intake on hypertension is well known in the general population, so some of our hypertensive subjects might have abstained from salt before visiting the hospital. This may be one of the reasons why the present study did not find any significant relationships between an affinity for salt and BP components.

Previous studies suggest that exercise (physical activity) may reduce BP levels and the risk of hypertension, but the associations have not always been consistent between studies. Our results did not find any association between exercise habits and any BP component. With respect to exercise habits, more detailed information such as intensity and frequency of exercise might be necessary, while it seems difficult to obtain such information in a routine busy practice in general medicine.

Few studies have examined the relationship between BP or hypertension and sleep status as a lifestyle-related factor. Although previous studies did not refer to BP components, shorter sleep duration could increase BP. Abnormal sleep status has adverse cardiovascular and endocrine effects, suggesting a link between lack of sleep and increased BP. We found a positive correlation between lack of sleep and DBP, which suggests the need for further study to confirm the relationship between sleep status and BP components, and to consider sleep status clinically as a means of DBP management.

Because these analyses were cross-sectional, our interpretation was restricted to exploring the cause and effect relationships between lifestyle-related factors and BP components in hypertensive individuals. Efforts to increase the reliability of self-reported data are also needed in a future study. Additionally, these findings were obtained from outpatient rooms in a hospital-based general medicine setting and so can not be gener-
alized because of the sampling bias in the study setting.

In conclusion, the respective BP components imply a clinical significance, and our results suggest that each lifestyle-related factor has a different influence on these BP components. Noting that the significance of lifestyle modification is emphasized as basic treatment for hypertension in the Japanese Society of Hypertension Guidelines for the Management of Hypertension, our findings could be useful to manage hypertension. For an efficient approach to dealing with hypertension in a hospital-based general medicine setting, weight control should receive strong attention in SBP, MBP and PP control, anti-smoking education in SBP and PP control, and sleep hygiene in DBP control.

References
10. Guideline subcommittee. 1999 World Health Organiza-


