



Original Article

# Rise of blood pressure value in young patients at first visit at a dental university hospital in Japan



Yasuyuki Kimura <sup>a</sup>, Ken-ichi Tonami <sup>a\*</sup>, Jun Tsuruta <sup>b</sup>,  
Kouji Araki <sup>c</sup>

<sup>a</sup> Oral Diagnosis and General Dentistry, Dental Hospital, Tokyo Medical and Dental University, Japan

<sup>b</sup> Institution of Education, Tokyo Medical and Dental University, Japan

<sup>c</sup> Educational System in Dentistry, Graduate School of Medical and Dental Science, Tokyo Medical and Dental University, Japan

Received 1 October 2018; Final revision received 20 November 2018

Available online 3 January 2019

## KEYWORDS

Hypertension;  
Biopsychosocial  
model;  
First visit medical  
interview

**Abstract** *Background/purpose:* Hypertension is a risk factor for stroke and heart disease. Psycho-social reasons are thought to influence blood pressure fluctuation in the dental clinic, but no previous studies have investigated these relationships. In this study, we analyzed a correlation between patients' blood pressure values and their backgrounds.

*Materials and methods:* We measured blood pressure in 4990 outpatients at our hospital. After determining the age groups in which blood pressure deviated from national averages, patients were classified into the Hypertension group and Normal group. Differences between these groups with regard to the prevalence of systemic disease, dental history and reasons for dental consultation were analyzed.

*Results:* Average systolic blood pressure of males in their 20's, 30's, 40's and females in their 20's, 30's, 40's, 50's was significantly higher than national averages. In these age groups, disease prevalence was significantly higher in the Hypertension group than in the Normal group. Furthermore, the Hypertension group expressed psycho-social reasons for dental consultation more frequently than the Normal group.

*Conclusion:* Relatively younger patients tended to show higher systolic blood pressure. It was suggested that psycho-social backgrounds as well as medical causes influenced the blood pressure increase.

© 2019 Association for Dental Sciences of the Republic of China. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

\* Corresponding author. Oral Diagnosis and General Dentistry, Dental hospital, Tokyo medical and Dental University, 1-5-45 Yushima, Bunkyo-ku, Tokyo, Japan. Fax +81 3 5803 5566.

E-mail address: [ken1.gend@tmd.ac.jp](mailto:ken1.gend@tmd.ac.jp) (K.-i. Tonami).

## Introduction

It is widely known that hypertension is one of the risk factors for stroke and heart disease,<sup>1</sup> and the mortality rate due to these diseases is high in Japan.<sup>2</sup> According to the National Health and Nutrition Examination Survey in 2013, about 60% of Japanese men and about 45% of Japanese women are hypertensive.<sup>3</sup> In Japan, 31% of fatalities in the dental clinic are caused by cardiac arrest and 25% of those are caused by cerebrovascular disorders. It is thought that these conditions could be induced by hypertension during dental treatment.<sup>4</sup> Thus, it is necessary for dentists to thoroughly understand management of the patient's blood pressure in the dental clinic.

Not only patients with chronic hypertension but also those with so-called white-coat hypertension show high blood pressure in the dental clinic. White-coat hypertension is a well known phenomenon in which patients exhibit high blood pressure in clinical settings even though they do not have hypertension in daily life. Especially during dental treatment, patients experience apprehension due to a sense of invasion in the oral cavity. As a result, the patients' blood pressure tends to rise easily due to their anxiety and stress caused by perceived stimuli. Moreover, use of a local anesthetic containing epinephrine may also contribute to elevating the patient's blood pressure during treatment. Therefore, it is very important to screen patient's blood pressure status during the dental consultation to ensure safe dental practice. However, in recent years, there has not been a large scale surveillance of patients' blood pressure during dental treatment. Thus, the actual conditions contributing to this problem are not yet clear.

In 1977, George Engel introduced the biopsychosocial model as an alternative to the disease-oriented medical system model in order to realize holistic therapy.<sup>5</sup> The biopsychosocial model provides a multidimensional perspective for understanding humans. Based on this idea, WHO (World Health Organization) defines health as "a state of complete physical, mental and social well-being." From this standpoint, high blood pressure may also be influenced by various bio, psycho and socio-aspects. In a previous study, we reported that 16% of new outpatients consulted a dental hospital for psychological and social reasons.<sup>6</sup> To date, there has not been any report investigating the relationship between patients' blood pressure fluctuations in dental clinics and their psychological and social backgrounds. In this study, we conducted a large-scale survey of blood pressure values of patients who visited university hospitals, and analyzed correlation between blood pressure values and the patients' biological, psychological and social background such as systemic diseases, reasons for visiting dental clinic.

## Materials and methods

### Subjects

Subjects were new outpatients who consulted our hospital between January 4, 2014 and June 30, 2014. In the waiting room before clinical examination, each patient filled out a

hospital health questionnaire that asks the reasons for dental consultation, their basic health condition and dental history. Then the blood pressure of each patient was measured using an automatic blood pressure measuring device in the clinic and the values were added to the health questionnaire before the medical interview began. If the questionnaire showed erroneous or missing data, the patient was excluded. As a result, data from 4990 of 6235 patients were available for analysis.

### Comparison with national averages

As a control, the national averages from the National Health and Nutrition Examination Survey Japan 2012 were employed in this study. In the survey, the data were compiled by age group in ten-year increments. Therefore, in this study, the subjects were divided into six groups: 20s, 30s, 40s, 50s, 60s, 70s and older, which are the same age classifications as used in the National Health and Nutrition Survey. The subjects' systolic and diastolic blood pressure values were extracted from the health questionnaire and statistically compared with the national average using one sample t test. The age groups in which the blood pressure value significantly differed from the national average were combined into a single group (hereafter, Group A) for each systole/diastole and male/female, respectively. The age groups in which the blood pressure value did not significantly differ from the national average were combined as a single group (hereafter, Group B) for each systole/diastole and male/female, respectively.

### Analysis for cause of hypertension

From the health questionnaire, subjects' systemic diseases, dental history and reasons for dental consultation were extracted. For systemic diseases, the presence/absence of heart disease, kidney disease, liver disease, cerebrovascular disease, diabetes, osteoporosis, tuberculosis, rheumatism, gastrointestinal disease, blood diseases, and epilepsy were examined. For dental history, we examined the presence/absence of adverse experiences during dental anesthesia and tooth extraction. The reasons for consultation were classified into biological and psycho-social reasons and used for subsequent analysis. Next, we divided subjects into two groups, Hypertension and Normal. The criteria for hypertension was 140 mmHg or more in systole blood pressure or 90 mmHg or more in diastole at the initial examination according to Guidelines for the Management of Hypertension 2014.<sup>7</sup> Then, differences between the Hypertension and Normal groups regarding the prevalence of each item of systemic disease, dental history and reasons for consultation were statistically analyzed using Chi-square test and Fisher's exact test for both group A and B, respectively. Furthermore, logistic regression analysis was performed with systemic disease (presence/absence), psychological and social reasons for consultation (presence/absence), gender (male and female), age (group A or B) as explanatory variables and Hypertension or Normal as the target variable.

## Statistical analysis

Statistical analysis software SPSS ver. 21 (IBM, New York, USA) was used for all statistical analyses. The level of significance was 5%.

## Ethical approval

The study protocol was approved by the Research Ethics Committee of Our University (#1250).

## Results

### Demographic of the subjects

Gender and age distributions of the 4990 subjects are shown in Fig. 1. The ratio of males and females was 34.4% and 65.6%. For both men and women, patients in their 60s comprised the largest age group.

### Comparison with national averages

The blood pressure values of the subjects and the national averages are shown in Fig. 2. The systolic blood pressure values of younger age groups, that is, 20's, 30's, 40's for males (Fig. 2A) and 20's, 30's, 40's, 50's for females (Fig. 2B), were significantly higher than the national averages ( $p < 0.05$ ). Therefore, these age groups were combined as Group A. On the other hand, the systolic blood pressure values of males over 50 years and females over 60 years did not differ from the national average, thus these age groups were combined as Group B. There were no significant differences in diastolic blood pressure between subjects and the national average for either gender (Fig. 2C,D).

### Hypertension and subjects' backgrounds

In both Group A and B, the overall prevalence of systemic disease was significantly greater in the Hypertension group than in the Normal group (Fig. 3A). When focusing on the individual diseases in Group A, the prevalence of cerebrovascular disorder and kidney disease was significantly greater among subjects with Hypertension than among Normal subjects (Fig. 3B). There was no difference in

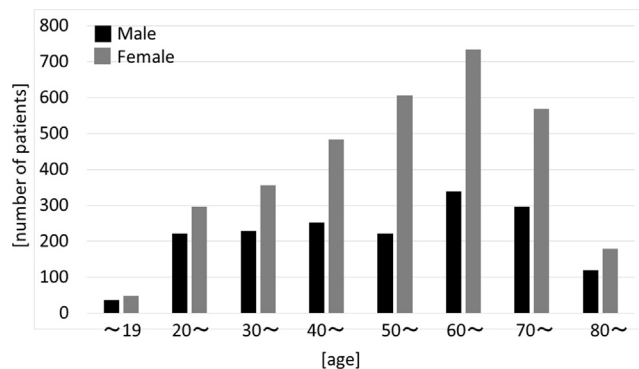


Figure 1 Gender and age distributions of the subjects.

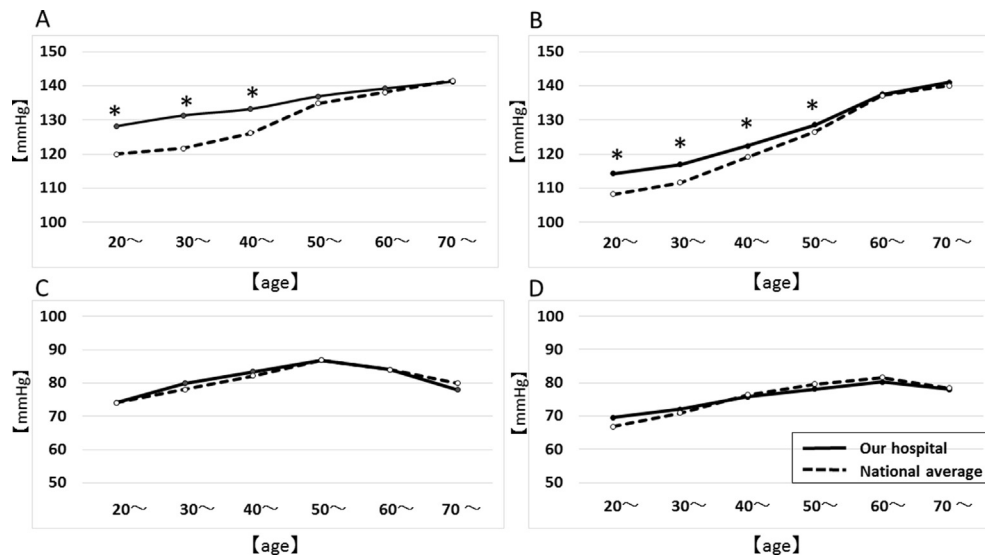
dental history between the Hypertension and Normal groups (Fig. 4A,B) for either Group A or B. In Group A, the number of subjects mentioning psycho-social reasons for dental consultation was greater in the Hypertension group than in the Normal group, but there was no significant difference in Group B (Fig. 4C). The Results of logistic regression analysis are shown in Table 1. Hypertension was highly correlated with age (Group A or B), gender and presence of systemic disease. Although the reason for consultation did not correlate with Hypertension, the interaction between age and reason for consultation demonstrated a strong correlation with Hypertension.

## Discussion

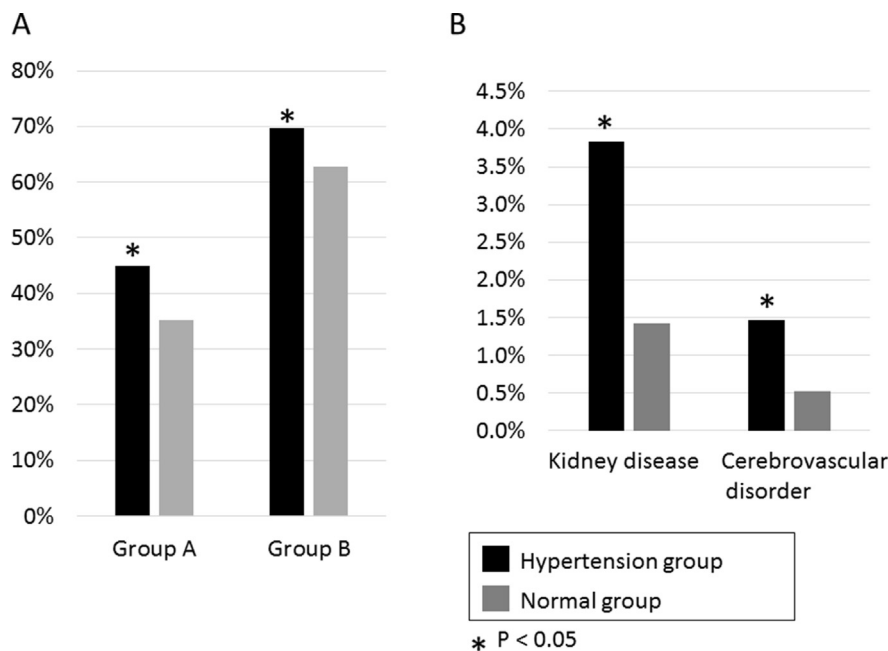
In this study, the blood pressure values of 4990 new outpatients of the Dental Hospital, TMDU were analyzed. The Results showed that relatively young patients demonstrated higher systolic blood pressure than the national average. Thus, we compared the backgrounds of younger patients with hypertension to those of patients with normal blood pressure using data from their self-administrated health questionnaire to clarify the cause(s) of such deviation in blood pressure values. In the analysis, we employed 140/90 mmHg or more as the hypertension criteria since this guideline is commonly used around the world.<sup>7,8</sup> As a result, we found that hypertension patients tended to have an underlying systemic disease, which suggests that the presence of an underlying disease affects hypertension during dental clinic visits. Especially, the prevalence of kidney disease and cerebrovascular disorder was higher among younger patients with hypertension. Both diseases have been reported to correlate with hypertension in a previous study.<sup>9</sup> The present results suggest that when a patient's blood pressure exceeds 140/90 mmHg in the dental clinic, the possibility of underlying diseases such as kidney disease and cerebrovascular disorder should be suspected.

Psychological and social reasons for dental consultation did not correlate with hypertension individually; however, the interaction between psycho-socio reasons and age showed a strong correlation with hypertension, indicating that younger patients tended to demonstrate high blood pressure because of psycho-socio reasons. Severe stress can be a factor in raising blood pressure.<sup>10,11</sup> There are reports that the influence of sympathetic nerve activity on blood pressure rise is slowed by age.<sup>12</sup> Greater sensitivity to the influence of psycho-socio factors on blood pressure might induce white coat hypertension in younger patients.

The leading cause of death in dentistry is anesthesia/sedation/medication-related complications.<sup>13</sup> Especially, a local anesthetic containing epinephrine may induce an increase in blood pressure and hypertensive patients are five times more sensitive to the effects of epinephrine.<sup>14</sup> Therefore, guidelines indicate that when blood pressure is 180/110 mmHg or higher, referral to a physician is given priority except in an emergency.<sup>15,16</sup> Thus, anesthesia for hypertensive patients should be carefully planned and conducted during dental treatment in order to avoid a hypertensive emergency. In this study, there was no correlation between hypertension and adverse experiences during



**Figure 2** The systolic blood pressure values of male (A) and female (B); The systolic blood pressure values of 20's, 30's, 40's for males and 20's, 30's, 40's, 50's for females were significantly higher than the national averages. The diastolic blood pressure values of male (C) and female (D); There were no significant differences between subjects and the national average for either gender.

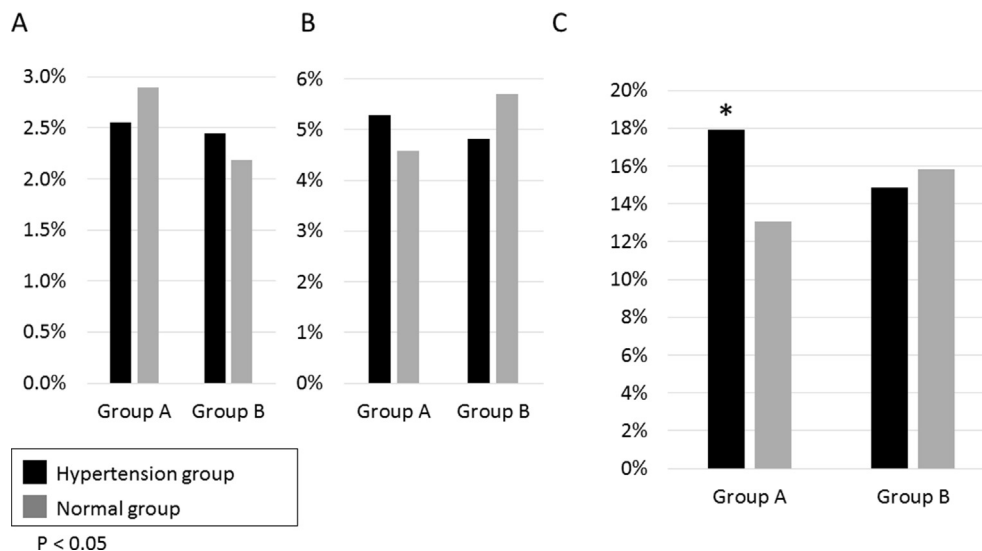


**Figure 3** (A) In both Group A and B, the overall prevalence of systemic disease was significantly greater in the Hypertension group than in the Normal group. (B) The prevalence of cerebrovascular disorder and kidney disease was significantly greater among subjects with Hypertension than among Normal subjects in Group A.

dental anesthesia and tooth extraction. In this study, 140/90 mmHg or higher was employed as the criteria for hypertension, which is rather lower than the guideline suggesting a value of 180/110 mmHg. This might be the reason that there was no correlation between past incidents and hypertension.

Some limitations exist in this study. First, a part of subjects had been diagnosed with essential hypertension and under treatment with antihypertensive drugs while others were not. That is, the subjects included both controlled and uncontrolled hypertensive patients.

Therefore, a subset of these blood pressure data was affected by such medication. Second, although there are many reports on the correlation between white coat hypertension and psychological factors,<sup>17</sup> it is difficult to identify distinct psychological considerations for hypertensive patients because it is difficult to distinguish between essential hypertension and white coat hypertension. We consider this issue a future task. Third, the survey was conducted only in the Dental Hospital, TMDU and the survey took place only for six months. Patients visit to local dental clinics might have more simple biopsychosocio-backgrounds



**Figure 4** (A) Adverse event at the time of anesthesia, (B) Adverse event at the time of extraction, (C) Rate of psycho-social reasons for consulting a dental clinic.

**Table 1** The result of logistic regression analysis; The interaction between age and reason for consultation demonstrated a strong correlation with Hypertension.

		B	Standard error	p	Exp (b)	95%CI
Systemic disease	:yes	0.371	0.065	* 0.000	1.450	1.277–1.646
reason for visiting	:psychological or social	−0.065	0.111	0.559	0.937	0.754–1.165
group	:A	−1.276	0.072	* 0.000	0.279	0.243–0.321
gender	:female	−0.348	0.065	* 0.000	0.706	0.622–0.802
psychological or social reason for visiting	x groupA	0.436	0.169	* 0.010	1.547	1.110–2.156

than those visit to the Dental Hospital. As a result, there is a possibility that the patients of local dental clinics have different tendency from those in the Dental Hospital. Further research surveying at various facilities is needed to discuss for generalizing the result.

In summary, this study indicated that relatively young patients attending the dental hospital (TMDU) tended to demonstrate a high systolic blood pressure at their first visit, and it was suggested that psychological and social backgrounds as well as medical causes may have influenced this blood pressure rise. Because white coat hypertension has been reported to develop into sustained hypertension<sup>18,19</sup>, blood pressure measurement at the first visit can be one of the indices for considering the background of a dental patient.

### Conflict of interest

None.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jds.2018.11.004>.

### References

1. Imano H, Kitamura A, Sato S, et al. Trends for blood pressure and its contribution to stroke incidence in the middle-aged Japanese population: the Circulatory Risk in Communities Study (CIRCS). *Stroke* 2009;40:1571–7.
2. *Vital Statistics Japan*. 2014.
3. *National Health and Nutrition Survey Japan*. 2012.
4. *J Jpn Dent Assoc* 2005;1069–83.
5. Engel GL. The need for a new medical model: a challenge for biomedicine. *Science* 1977;196:129–36.
6. Kimura Yasuyuki, Tonami Ken-ichi, Mataka Shiro, et al. Analysis of new outpatients' responses to a survey of their reasons for visiting a dental clinic. *Eur J Gen Dent* 2017;6:111–4.
7. *Guidelines for the management of hypertension*. 2014.
8. Whitworth JA, World Health Organization International Society of Hypertension Writing Group. World health organization(-WHO)/International society of hypertension (ISH) statement of management of hypertension. *J Hypertens* 2003;21:1983–92.
9. *Yoshihiro Takasugi Synopsis of systemic diseases for clinical dentistry Gakkensyoin*. 2013.
10. Pickering TG. Could hypertension be a consequence of the 24/7 society? The effects of sleep deprivation and shift work. *J Clin Hypertens* 2006;8:819–22.
11. Ohkubo T, Kikuya M, Metoki H, et al. Prognosis of “masked” hypertension and “white-coat” hypertension detected by 24-h ambulatory blood pressure monitoring 10-year follow-up from the Ohasama study. *J Am Coll Cardiol* 2005;46:508–15.

12. Joyner MJ, Charkoudian N, Wallin BG. Sympathetic nervous system and blood pressure in humans: individualized patterns of regulation and their implications. *Hypertension* 2010;56: 10–6.
13. Death related to dental treatment: a systematic review. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2017;123:194–204.
14. Sasaki Kiyoshi. A study on the vasoconstrictors contained in local anesthetic solutions. *J Jpn Dent Soc Anesthesiol* 1979;7: 320–43.
15. Herman WW, Konzelman Jr JL, Prisant LM. Joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. new national guidelines on hypertension: a summary for dentistry. *J Am Dent Assoc* 2004; 135:576–84.
16. Tsuchihashi T, Takata Y, Kurokawa H, et al. Blood pressure response during dental surgery. *Hypertens Res* 1996;19: 189–94.
17. Siegel WC, Blumenthal JA, Divine GW. Physiological, psychological, and behavioral factors and white coat hypertension. *Hypertension* 1990;16:140–6.
18. Ugajin T, Hozawa A, Ohkubo T, et al. White-coat hypertension as a risk factor for the development of home hypertension: the Ohasama study. *Arch Intern Med* 2005;165:1541–6.
19. Mancia G, Facchetti R, Bombelli M, et al. Long-term risk of mortality associated with selective and combined elevation in office, home, and ambulatory blood pressure. *Hypertension* 2006;47:846–53.