Original Article

BODY WEIGHT AND WHITE COAT HYPERTENSION

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ABSTRACT

Objective: To understand prognostic significance of white coat hypertension (WCH), and any its association with excess weight.

Methodology: We studied consecutive check up patients between the ages of 35 and 70 years to be able to see possible consequences of excess weight on health and to avoid debility induced weight loss in elderly people.

Results: The study included 721 cases (426 females). Prevalences of normal weight, overweight, and obesity were detected as 19.0%, 43.3%, and 37.5%, respectively. There were gradual and significant increases in the prevalences of WCH and hypertension (HT) towards the overweight and obesity groups ($p<0.001$ for all). So 73.7% of the obesity cases had either WCH or HT, and overall prevalence of WCH was 37.9%, which was nearly equal to the prevalence of obesity. When we compared the groups according to the prevalences of hyperbetalipoproteinemia, dyslipidemia, diabetes mellitus (DM), and coronary heart disease (CHD), gradual and significant increases towards the overweight and obesity groups were seen nearly in all steps.

Conclusion: There is gradual increased prevalence of WCH in the overweight and obesity groups, parallel to gradually increased prevalences of hyperbetalipoproteinemia, dyslipidemia, HT, DM, and CHD. In addition nearly equal prevalence of WCH with obesity, and additional very low prevalence of sustained normotension in obesity group, WCH should be accepted as an alarming sign of excess weight and many associated disorders in future rather than just being a predisposing factor of HT and atherosclerosis alone. Its management should be focused on prevention of excess weight.

KEY WORDS: Excess weight, normotension, white coat hypertension, hypertension.

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INTRODUCTION

Excess weight is associated with increased levels of inflammatory markers[1] and many systemic disorders including hypertension (HT), type 2 diabetes mellitus (DM), dyslipidemia, coronary heart disease (CHD), increased mortality rate, and several types of cancers including breast, colon, and prostate cancers.[2-4] On the other hand, cardiovascular diseases (cardiovascular death, myocardial infarction, and stroke) are the most common causes of deaths, particularly in the developed countries[5], and most of them are related with HT.[6]

Thus blood pressure (BP) control is the mainstay for prevention of the cardiovascular diseases. But diagnosis and management of HT is

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difficult due to the fact that BP varies greatly depending on physical and mental stresses. White coat hypertension (WCH) is a well known clinical entity defined as a persistently elevated BP in the doctor's office, whereas normal in other conditions, and prognostic significance of it remains controversial. WCH was a risk factor for home HT in Ohasama study.[7] Similarly, 60 subjects (46.9%) with WCH and 144 (22.2%) with sustained NT have progressed to home HT in an eight-year follow up study.[8] Additionally, intima-media thickness and cross-sectional area of carotid artery have been found as similar in patients with WCH and HT, which were significantly higher than the sustained normotensives'.[9] On the other hand, there has not been any evidence that WCH exhibits a clearly higher risk for cardiovascular events in the above 7.4-year follow up study.[10] In another study, complication risks of WCH have not been found as different from subjects with sustained NT.[11] So most of the already performed studies of WCH have just focused on the progression to home HT in time, or whether or not it already causes target organ damage.

Our objective was to understand other prognostic features of WCH, and if it had any association with body weight in the study population.

METHODOLOGY

The study was performed in the Internal Medicine Polyclinic of the Dumlupinar University between August 2005 and April 2006. We took consecutive check up patients aged between 35 and 70 years to be able to see possible consequences of excess weight on health and to avoid debility induced weight loss in elders. Their medical histories including smoking habit and medications were looked into , and a routine check up procedure including fasting plasma glucose (FPG), low density lipoprotein cholesterol (LDL-C), triglyceride (TG), high density lipoprotein cholesterol (HDL-C), and an electrocardiography was performed. Current daily smokers at least for the last 12 months and cases with a smoking history of at least five pack-years were accepted as smokers, and cigar or pipe smokers were excluded. Insulin using diabetics and patients with devastating illnesses including malignancies, acute or chronic renal failure, chronic liver diseases, hyper- or hypothyroidism, and heart failure were excluded to avoid their possible effects on weight.

Body mass index (BMI) of each case was calculated. Weight in kilograms is divided by height in meters squared, and obesity is defined as a BMI of 30 or greater, overweight as 25–29.9, normal weight as 18.5-24.9, and underweight as a BMI of lower than 18.5 kg/m.[2,12] Office blood pressure (OBP) was checked after a 5-minute of rest in seated position with the mercury sphygmomanometer on three visits, and no smoking was permitted during the previous two-hour. A 10-day twice daily measurement of blood pressure at home (HBP) was obtained in all cases, even in normotensives in the office due to the risk of masked hypertension after a 10-minute education about proper BP measurement techniques.[13]

A 24-hour ambulatory blood pressure monitoring (ABP) was obtained just in cases with high OBP and/or HBP measurements, and it was performed with oscillometrical equipment (SpaceLabs 90207, Redmond, Washington, USA) set to take a reading every 10-minute throughout the 24-hour. Eventually, HT is defined as a BP of 135/85 mmHg or greater on mean daytime (between 10 AM to 8 PM) ABP.[13] WCH is defined as OBP of 140/90 mmHg or greater, but mean daytime ABP of <135/85 mmHg, sustained normotension (NT) as OBP of <140/90 mmHg together with an average HBP of <135/85 mmHg, and masked HT as OBP of <140/90 mmHg, but mean daytime ABP of 135/85 mmHg or greater.[13] Cases with an overnight FPG level of 126 mg/dL or higher on two occasions or already taking antidiabetic medications were defined as diabetics.

An oral glucose tolerance test with 75-gram glucose was performed in cases with a FPG level between 110 and 126 mg/dL, and diagnosis of cases with a 2-hour plasma glucose level of 200 mg/dL or greater is diabetes mellitus (DM). Additionally patients with dyslipidemia were

Table-I: Characteristic features of the study cases

Variables	*Normal weight*	*p-value*	*Overweight*	*p-value*	*Obesity*
Number	137		312		270
Prevalence	19.0%		43.3%		37.5%
Mean age and range (year)	39.0 ± 8.7 (35-70)	<0.01	47.4 ± 9.6 (35-70)	<0.05	54.3 ± 8.8 (35-70)
Female ratio	47.4% (65)	ns*	47.7% (149)	<0.001	78.5% (212)
Prevalence of smoking	35.0% (48)	ns	31.7% (99)	<0.001	19.2% (52)

*Nonsignificant (p>0.05)

detected, and we used the National Cholesterol Education Program Expert Panel's recommendations for defining dyslipidemic subgroups.[12] Dyslipidemia is diagnosed with a LDL-C value of 160 or greater and/or a TG value of 200 or greater and/or a HDL-C value of <40 mg/dL. A stress electrocardiography was performed in suspected cases, and a coronary angiography was obtained only for the stress electrocardiography positive cases. Prevalences of the smoking, sustained NT, WCH, HT, DM, hyperbetalipoproteinemia, dyslipidemia, and coronary heart disease (CHD) were detected in the underweight, normal weight, overweight, and obesity groups, and results were compared in between. Comparison of proportions was used as the method of statistical analysis.

RESULTS

The study included 721 cases (426 females). There were only two cases (two males) (0.27%) in the underweight group, thus this group was not taken for comparison. Prevalences of smokers were 35.0%, 31.7%, and 19.2% in the normal weight, overweight, and obesity groups, and the differences between the obesity and the other two groups were significant (p<0.001 for both). But the female predominance of the obesity group was probably the cause of the difference (Table-I).

Since 146 of the detected 199 smokers were male, and prevalences of smokers were 49.8% (146/293) versus 12.4% (53/426) in the males and females. There were gradual and statistically significant increases in the prevalences of WCH and HT beside the gradual and statistically significant decrease in the sustained NT from the normal weight towards the overweight and obesity groups (p<0.001 for all) (Table 2). Eventually, the prevalences of WCH and HT were up to 52.2% (141 cases) and 21.4% (58 cases) in the obesity group, respectively. In other words, 73.7% of the obese cases had either WCH or HT. The 382 patients with WCH and HT were both diagnosed via HBP and ABP, and no difference was observed between the two methods according to the diagnosed numbers of cases with WCH or masked or obvious HT. Mean systolic/diastolic OBP, HBP, and ABP values are given in Table 3. It was observed on ABP that the white coat effect was initiated by leaving home to come to hospital. Eleven of the 109 hypertensive cases (10.0%) actually had masked HT. Additionally, when we compared

Table-II: Blood pressure variabilities of the study cases

Variables	*Normal weight*	*p-value*	*Overweight*	*p-value*	*Obesity*
Prevalence of sustained normotension	75.1% (103)	<0.001	52.2% (163)	<0.001	26.2% (71)
Prevalence of white coat hypertension	17.5% (24)	<0.001	34.6% (108)	<0.001	52.2% (141)
Prevalence of hypertension	7.2% (10)	<0.001	13.1% (41)	<0.001	21.4% (58)

Table-III: Mean blood pressure values of the study cases

Variables	*Sustained NT**	*WCH†*	*Masked HT‡*	*Sustained HT*
Prevalence	46.8% (337)	37.9% (273)	1.5% (11)	13.6% (98)
Mean Office BP§	123.2 ± 6.3/83 ± 3.3	144.3 ± 5.6/91.3 ± 5.6	131.2 ± 4.7/83.7 ± 5.2	164.7 ± 5.7/103.8 ± 4.3
Mean home BP	117.2 ± 7.3/77.8 ± 5.5	122.4 ± 4.1/71.3 ± 3.7	142.1 ± 5.5/91.3 ± 3.6	143.3 ± 3.5/93.6 ± 3.5
Mean ABPQ%	Not performed	125.3 ± 3.7/77.1 ± 3.3	146.3 ± 3.3/95.7 ± 4.1	145.2 ± 3.3/93.5 ± 4.1

*Normotension †White coat hypertension ‡Hypertension §Blood pressure Q%24-hour ambulatory blood pressure monitoring

the three groups according to DM, hyperbetalipoproteinemia, dyslipidemia, and CHD, the gradual and significant increases from the normal weight towards the overweight and obesity groups were nearly seen in all steps (Table-IV).

DISCUSSION

White Coat Hypertension (WCH) is a condition characterized by elevated BP in medical settings combined with normal ABP or self-measured HBP. As already detected in a previous study by us[14] and as additionally here, the both methods were equally effective for the diagnosis of WCH and HT. Similarly, recent HT guidelines propose self-measurement of HBP as an important means to evaluate response to antihypertensive therapy, to improve compliance with therapy, and most importantly, as an alternative to ABP to confirm or refute the WCH.[15] Appropriateness of HBP to guide antihypertensive treatment was only tested in one large-scale randomized trial: the THOP (Treatment of Hypertension Based on Home or Office Blood Pressure) trial, and it was shown that antihypertensive treatments based on home instead of office BP led to less intensive drug treatments, but also to less effective BP control with no difference in general well being and left ventricular mass.[16]

In another study, both ABP and HBP appeared to be appropriate methods for detection of masked HT[17], as another handicap of the OBP measurements. In the previous study[14], we observed very high prevalences of WCH in society, 33.3% in the second, 46.6% in the third, 50.0% in the fourth, 48.9% in the fifth, 36.9% in the sixth, 19.2% in the seventh, and 8.3% in the eighth decades of life. Prevalence of HT initially started to be higher than 40% in the sixth and it reached up to 75% in the eighth decades of life. On the other hand, the prevalence of HT was detected as only 3% in the third, 8% in the fourth, and 21% in the fifth decades of life in the same study.

The high prevalences of WCH in society were also shown in some other reports.[18,19] So as a hypothesis, we had come to the conclusion that all hypertensives, 75% in the eighth decade, may arise from the previously WCH cases, but this process takes a very long period of time, reaching up to the normal life span of human being. Similarly, in a recent review article it was

Table-IV: Associated disorders of the study cases

Variables	*Normal weight*	*p-value*	*Overweight*	*p-value*	*Obesity*
Prevalence of diabetes mellitus	9.4% (13)	<0.001	19.2% (60)	ns*	21.1% (57)
Prevalence of hyperbetalipoproteinemia	11.6% (16)	ns	14.4% (45)	<0.05	19.6% (53)
Prevalence of dyslipidemia	20.4% (28)	<0.001	32.6% (102)	ns	36.2% (98)
Prevalence of coronary heart disease	10.9% (15)	ns	10.5% (33)	<0.001	18.1% (49)

*Nonsignificant (p>0.05)

postulated that patients with WCH are characterised by the following features: absence of organ damage induced by HT, absence of risk of future cardiovascular disease related to HT, and absence of lowering of BP from antihypertensive treatment.[20]

As an important point of the present study, we evaluated the WCH not as a cause of HT or atherosclerosis, but as a coexisting, thus an alarming sign of something going bad for health. When we compared the normal weight, overweight, and obesity groups according to BP variability, beside the significantly decreased prevalences of sustained NT from the normal weight towards the overweight and obesity groups, both the prevalences of WCH and HT were increased in the same direction significantly (p<0.001 in all). So the prevalence of WCH had increased parallel to the increasing prevalences of HT, DM, hyperbetalipoproteinemia, dyslipidemia, and CHD, when we go from the normal weight towards the overweight and obesity groups, significantly. Eventually, the prevalences of WCH and HT were reached up to 52.2% and 21.4% in the obesity group, respectively. In other words, only 26.2% of the obese cases had sustained normotension.

On the other hand, when we looked at the prevalence of WCH in all study cases, it was detected as 37.9% (273 patients), which was nearly equal to the prevalence of obesity cases, 37.5% (270 patients). In the previous study, we detected the prevalences of WCH 33.3% even in the second and 46.6% in the third decades of life[14], despite lower prevalences of overweight and obesity in these age groups than adults. So WCH may be an indicator of excess weight and many associated disorders in future.

Relationship between the excess weight and HT is also described under the heading of the metabolic syndrome, and clinical manifestations of the syndrome include abdominal obesity, dyslipidemia, HT, insulin resistance, and proinflammatory as well as prothrombotic states. Obesity leads to both structural and functional abnormalities of the cardiovascular system. In general, obese individuals will have an increased circulating blood volume as well as an increased volume of cardiac output, thought to be the result of increased oxygen demand of the extra body tissue. The prolonged increase in circulating blood volume can lead to myocardial hypertrophy and decreased compliance, in addition to the common comorbidity of HT. In addition to HT, the prevalences of high FPG, high serum total cholesterol, and low HDL-C, and their clustering were all raised with increases in BMI.[21] Combination of these cardiovascular risk factors will eventually lead to an increase in left ventricular stroke work with a higher risk of arrhythmia, cardiac failure, or even sudden cardiac death.

We conclude that there is gradual increasesed prevalences of WCH in the overweight and obesity groups, parallel to the gradually increased prevalences of hyperbetalipoproteinemia, dyslipidemia, HT, DM, and CHD like disorders. In addition there is an equal prevalence of WCH with obesity in population, and additional very low prevalence of sustained NT in the obesity cases. Hence WCH should be accepted as an alarming sign of excess weight and many associated disorders in future, rather than being just a predisposing factor of HT and atherosclerosis alone, and its management should be focused on prevention of excess weight.

REFERENCES

1. Saito I, Yonemasu K, Inami F. Association of body mass index, body fat, and weight gain with inflammation markers among rural residents in Japan. Circ J 2003;67:323-329.
2. Alpert MA, Lambert CR, Terry BE, Cohen MV, Mukerji V, Massey CV, et al. Influence of left ventricular mass on left ventricular diastolic filling in normotensive morbid obesity. Am Heart J 1995;130:1068-1073.
3. Kuchta KF. Pathophysiologic changes of obesity. Anesthesiol Clin North America 2005;23:421-429.
4. Calle EE, Thun MJ, Petrelli JM, Rodriguez C, Heath CW Jr. Body-mass index and mortality in a prospective cohort of U.S. adults. N Engl J Med 1999;341:1097-1105.
5. Ridker PM, Libby P. Risk Factors for Atherothrombotic Disease. In Douglas P. Zipes, Peter Libby, Robert O. Bonow, Eugene Braunwald (eds): Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine 7th Ed. Philadelphia, Pennsylvania, Elsevier Saunders 2005;939-958.

6. Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJ: Comperative Risk Assessment Collaborating Group. Selected major risk factors and global and regional burden of disease. Lancet 2002;360:1347-1360.
7. Ohkubo T, Asayama K, Kikuya M, Metoki H, Hoshi H, Hashimoto J, et al. How many times should blood pressure be measured at home for better prediction of stroke risk? Ten-year follow-up results from the Ohasama study. J Hypertens 2004;22:1099-1104.
8. Ugajin T, Hozawa A, Ohkubo T, Asayama K, Kikuya M, Obara T, et al. White-coat hypertension as a risk factor for the development of home hypertension: the Ohasama study. Arch Intern Med 2005;165:1541-1546.
9. Nakashima T, Yamano S, Sasaki R, Minami S, Doi K, Yamamoto J, et al. White-coat hypertension contributes to the presence of carotid arteriosclerosis. Hypertens Res 2004;27:739-745.
10. Polonia JJ, Gama GM, Silva JA, Amaral C, Martins LR, Bertoquini SE. Sequential follow-up clinic and ambulatory blood pressure evaluation in a low risk population of white-coat hypertensive patients and in normotensives. Blood Press Monit 2005;10:57-64.
11. Fagard RH, Van Den Broeke C, De Cort P. Prognostic significance of blood pressure measured in the office, at home and during ambulatory monitoring in older patients in general practice. J Hum Hypertens 2005;19:801-807.
12. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. Circulation 2002;17:106:3143-3421.
13. O'Brien E, Asmar R, Beilin L, Imai Y, Mallion JM, Mancia G, et al. European Society of Hypertension recommendations for conventional, ambulatory and home blood pressure measurement. J Hypertens 2003;21:821-848.
14. Helvaci MR, Seyhanli M. What a high prevalence of white coat hypertension in society! Intern Med 2006;45:671-674.
15. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al; National Heart, Lung, and Blood Institute Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; National High Blood Pressure Education Program Coordinating Committee. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA 2003;289:2560-2572.
16. Hond ED, Celis H, Fagard R, Keary L, Leeman M, O'Brien E, et al; THOP investigators. Self-measured versus ambulatory blood pressure in the diagnosis of hypertension. J Hypertens 2003;21:717–722.
17. Stergiou GS, Salgami EV, Tzamouranis DG, Roussias LG. Masked hypertension assessed by ambulatory blood pressure versus home blood pressure monitoring: is it the same phenomenon? Am J Hypertens 2005;18:772-778.
18. Hozawa A, Ohkubo T, Kikuya M, Yamaguchi J, Ohmori K, Fujiwara T, et al. Blood pressure control assessed by home, ambulatory and conventional blood pressure measurements in the Japanese general population: the Ohasama study. Hypertens Res 2002;25:57-63.
19. Celis H, Fagard RH. White-coat hypertension: A clinical review. Eur J Intern Med 2004;15:38-357.
20. Verdecchia P, Staessen JA, White WB, Imai Y, O'Brien ET. Properly defining white coat hypertension. Eur Heart J 2002;23:106-109.
21. Zhou B, Wu Y, Yang J, Li Y, Zhang H, Zhao L. Overweight is an independent risk factor for cardiovascular disease in Chinese populations. Obes Rev 2002;3:147-156.

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