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Prevalence of White Coat Effect in Treated Hypertensive Patients in the Community

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Patients receiving drug therapy for hypertension in the tertiary care setting frequently exhibit higher office readings compared to ambulatory blood pressure values (white coat effect). In this study, the prevalence of a white coat effect was determined in an unselected population of 147 hypertensive patients receiving treatment from their family physicians in the community. The proportion of patients with a white coat effect (defined as office − ambulatory blood pressure ≥ 20/10 mm Hg) was significantly ($P < .001$) higher when based upon the family physician's routine blood pressure readings (91/147), compared to special readings taken by the family physician for the study (54/147) or readings taken by a research nurse (30/147). There was a higher correlation ($P < .05$) between the ambulatory systolic blood pressure and the nurse's readings (r = 0.62) or special physician's readings (r = 0.55) *v* the routine physician's readings (r = 0.34). Left ventricular mass index as measured by echocardiography correlated ($P < .01$) with the special physician (r = 0.27), nurse (r = 0.23), and ambulatory systolic blood pressure readings (r = 0.24), but not with the routine physician's readings (r = 0.06). A white coat effect is frequently present in treated hypertensive patients when blood pressure is recorded by family physicians in routine clinical practice. Am J Hypertens 1995;8:591–597

KEY WORDS: **White coat hypertension, blood pressure measurement.**

A diagnosis of hypertension is generally based upon the presence of persistently high office blood pressure readings during several visits. Statistically, most patients with hypertension will have only modest increases in blood pressure. In a national survey of a sample of the American population, 30% of those screened had a diastolic blood pressure above 90 mm Hg, but three-quarters of these individuals had readings under 105 mm Hg.[1] Current national and international guidelines recommend consideration of drug therapy if blood pressure exceeds 160/90 mm Hg despite nonpharmacologic interventions.[2–4] Thus, criteria for treating patients with mild to moderate hypertension will affect a majority of the total hypertensive population.

The availability of ambulatory blood pressure monitoring has led to increasing concern that a diagnosis of hypertension based solely upon office readings may result in the treatment of patients who do not have persistently high blood pressure values. Population surveys with ambulatory recording devices have generally reported that 20% to 25% of people with mild office hypertension have normal blood pressure values during usual daily activities.[5,6] Also, individuals with white coat hypertension appear to suffer fewer cardiovascular complications than patients with more persistent hypertension, particularly in the absence of coexisting target organ damage.[7,8] Since the decision to treat has been based almost entirely upon the office blood pressure, it is likely that

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many patients with white coat hypertension and no target organ damage are currently receiving antihypertensive drug therapy.

In an earlier study,[9] we reported that almost three-quarters of treated hypertensive patients referred to a tertiary care center exhibited a white coat effect, with the office blood pressure exceeding the mean awake ambulatory blood pressure by at least 20/10 mm Hg. The relevance of these findings to hypertensive patients under the care of primary care physicians in the community is uncertain. The present study was therefore undertaken to determine the prevalence of a white coat effect in an unselected group of treated hypertensive patients without target organ damage who are being followed by their own physicians in an urban community. This survey also included an examination of different approaches to measuring blood pressure in relation to the prevalence of a white coat effect and to left ventricular mass, a sensitive indicator of target organ damage.

METHODS

Patient Population Eligible subjects included men and women between the ages of 21 and 80 years who were receiving antihypertensive medication under the supervision of their primary care family physician. They were free of target organ damage (ischemic heart disease, congestive heart failure, cerebrovascular disease, renal impairment, and peripheral vascular disease), did not have a secondary cause for their hypertension, and had no cardiac arrhythmias which could interfere with the ambulatory blood pressure recording. Patients were also excluded if they were receiving medication for other conditions which could affect blood pressure or if their antihypertensive therapy had been changed within the preceding 3 months.

Two research nurses screened the office files of six family physicians (three male, three female) to identify patients on treatment for hypertension. Of the 287 patients who met the above eligibility criteria, 105 refused to participate in the study, 19 could not be contacted, and 16 were unable to attend for the office and ambulatory blood pressure readings because of a variety of reasons. The remaining 147 patients were entered into the study and consisted of 56 men and 91 women with a mean age of 64 ± 1 years.

The six family physicians were selected as being representative of good quality medical care in the local community based upon previous referrals and other interaction between them and the study investigators. All six family physicians had an affiliation with a university teaching hospital.

Study Design and Procedures Office and 24-h ambulatory blood pressures were recorded during a 2-week period. Patients were seen on two occasions by a specially trained research nurse and blood pressure was recorded using a mercury column sphygmomanometer after patients had been seated comfortably in a quiet room without conversation for 5 min. The first reading was discarded, then two additional readings were taken. If these differed by more than 10 mm Hg systolic or 5 mm Hg diastolic, a third reading was taken. The mean of the two or three office readings was then obtained.

The patient's family physician was asked to record a set of blood pressure readings using this same protocol. In addition, the nurses extracted the mean office blood pressure from one or more visits to the family physician during the preceding 3 months. The family physicians were unaware of this aspect of the protocol in order not to bias the blood pressure readings being performed for study purposes. Sitting office blood pressure readings were designated as being taken by the research nurse, "special" family physician reading for the study, and "usual" family physician reading, as recorded in the patient's office records.

During the same 2-week interval, each patient underwent two separate ambulatory blood pressure recordings using a SpaceLabs model 90202 or 90207 device (Redmond, WA). A 14- to 16-h mean awake ambulatory blood pressure was obtained on each of two separate weekdays during usual daily activities. The calibration of the ambulatory blood pressure device was verified for each recording using a mercury column sphygmomanometer with concurrent readings being taken by means of a T-tube connector. Ambulatory readings were taken at 15-min intervals and mean values computed. The results of the two ambulatory recordings were then averaged to obtain the mean awake ambulatory blood pressure. A white coat effect was defined as being a difference of at least 20 mm Hg systolic or 10 mm Hg diastolic between the office and ambulatory blood pressure values.[9]

Left ventricular mass index was estimated by two-dimensional echocardiography using the formula of Devereux and Reichek.[10] The echocardiograms were also performed during this same 2 week period. We have previously published reproducibility data on the calculation of left ventricular mass index from echocardiograms.[11]

A score for the intensity of antihypertensive drug therapy was determined for each patient using approximate dosage equivalents (eg, one drug unit equals 25 mg hydrochlorothiazide, 50 mg atenolol, or 40 mg nifedipine). Of the 147 patients entered into the study, 84 received up to one drug unit, 41 patients received one or two drug units, and the remaining 23 patients received three or more drug units.

Differences in demographic data, blood pressure,

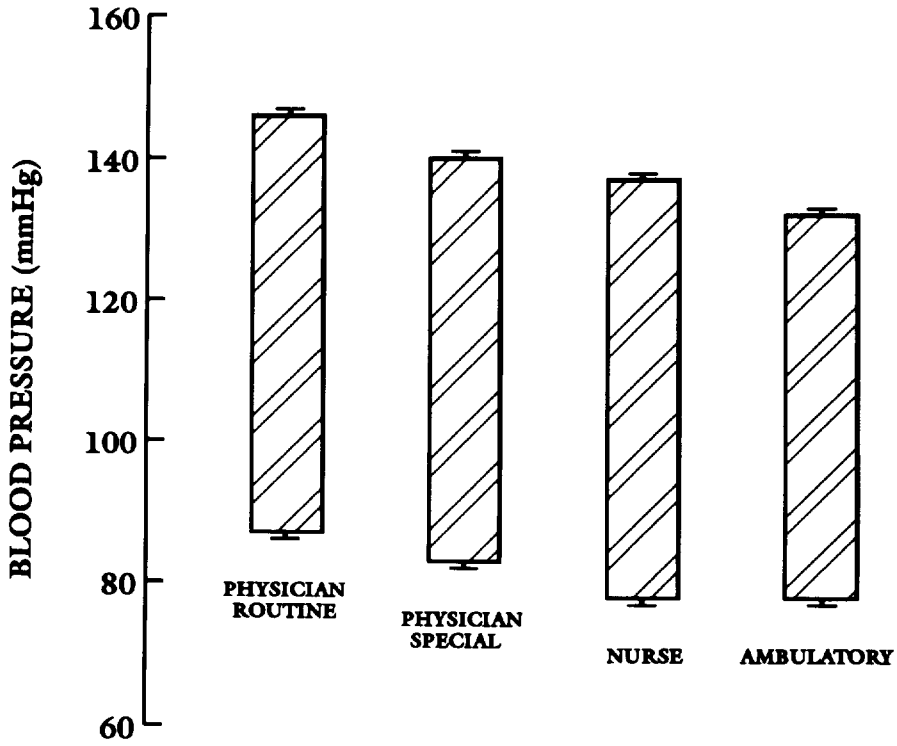

FIGURE 1. *Mean (±SEM) blood pressure values are shown for measurements taken by the patients' own physician (special for the study and routine office readings), by the research nurse, and mean awake ambulatory blood pressure. All office readings with the exception of the nurse diastolic blood pressure were significantly (P < .001) different from the ambulatory blood pressure.*

and left ventricular mass index within and between groups were evaluated using Student's *t* test. Student-Newman-Keul's procedure was used for multiple comparisons. Results expressed as proportions were analyzed using the χ^2 test and the relationships between continuous variables were assessed using Pearson's coefficient of correlation. Differences between coefficients of correlation were assessed using Z-transformation of data and the normal curve deviate. Continuous variables are expressed as mean ± standard error of the mean.

RESULTS

Mean office blood pressure readings taken by the patient's family physician were higher than mean ambulatory blood pressure values (Figure 1). For paired comparisons, there was a significant ($P < .001$) difference between the ambulatory blood pressure (132 ± 1/78 ± 1) *v* the family physician routine (146 ± 1/87 ± 1) and special (140 ± 1/83 ± 1) office readings and the nurse office readings (137 ± 1/78 ± 1), except for the nurse diastolic value ($P > .05$).

The proportion of patients with a white coat effect (defined as office minus ambulatory blood pressure ≥ 20/10 mm Hg) based upon the family physician's routine office blood pressure was significantly ($P < .001$) higher (91/147) than the proportion derived from the special family physician readings (54/147), as shown in Figure 2. Similarly, the nurses obtained a significantly ($P < .001$) lower proportion of white coat effect patients (30/147) compared to the family physicians' readings. The relationship between office systolic and diastolic blood pressure and white coat effect for individual patients is shown in Figure 3.

Higher ($P < .05$) coefficients of correlation were observed when ambulatory systolic/diastolic blood pressures were compared with nurse (r = 0.62/r = 0.58) or special physician (r = 0.55/r = 0.59) office readings *v* routine physician office values (r = 0.34/r = 0.33).

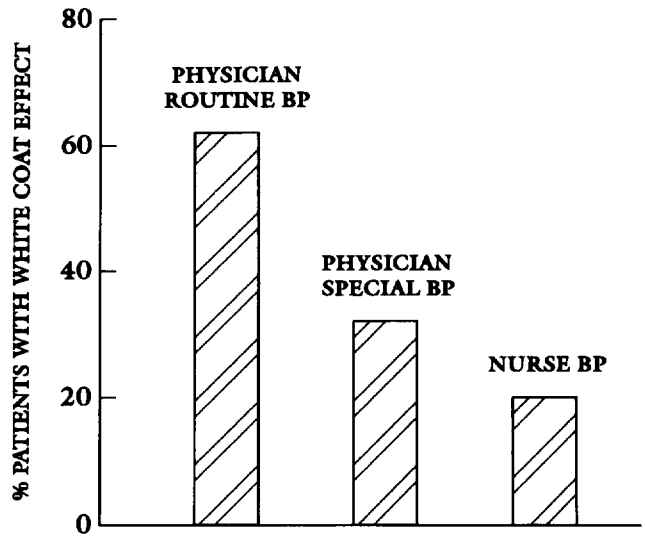

FIGURE 2. *Percent of patients exhibiting a white coat effect based upon blood pressure (BP) measurements taken by the physician for the study (special), physician's routine office reading, and research nurse's reading.*

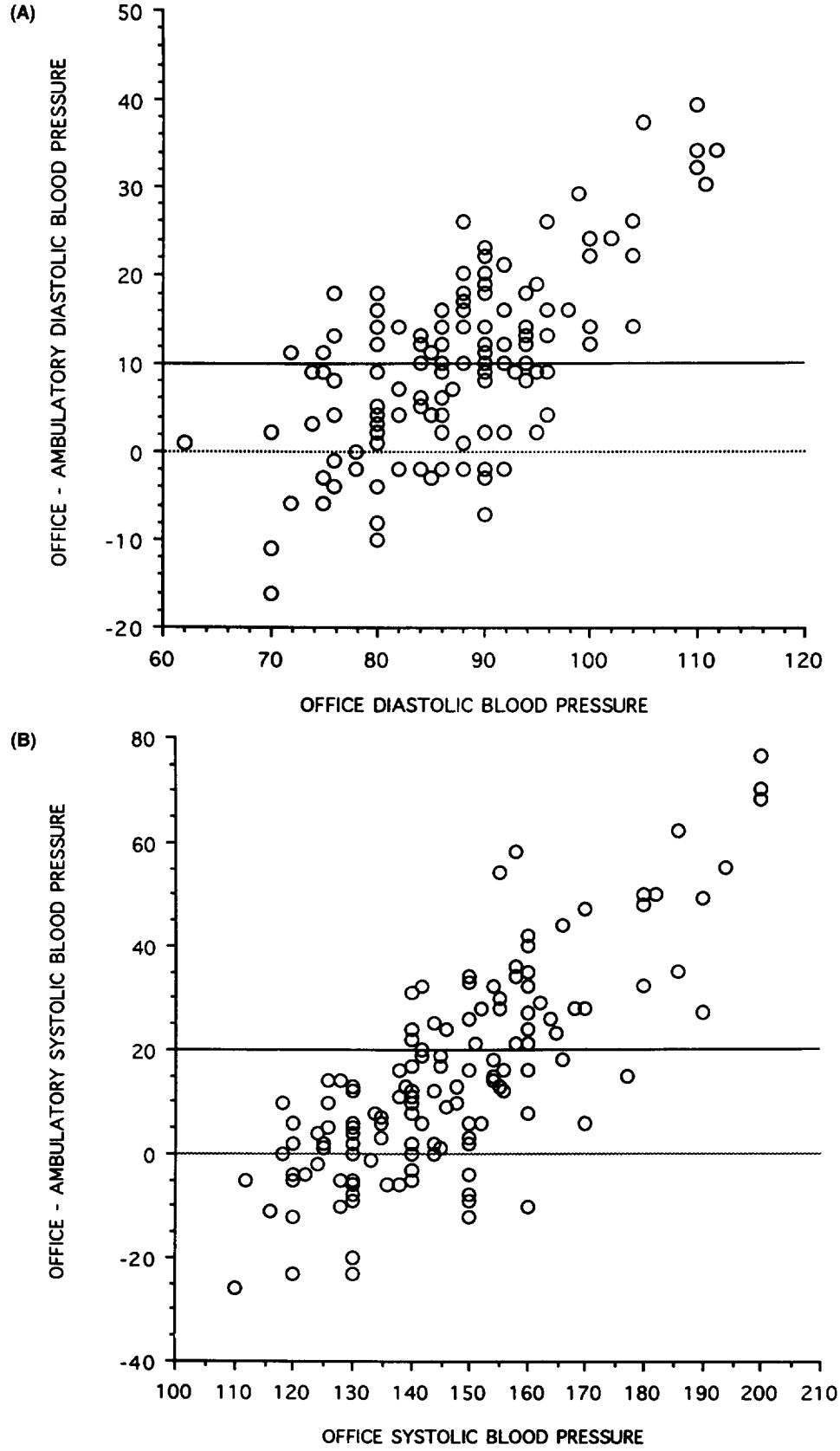

FIGURE 3. *Relationship between office diastolic (**A**) and systolic (**B**) blood pressure and the difference between office and ambulatory blood pressure for individual subjects. Data points above 20 mm Hg systolic or 10 mm Hg diastolic represent patients with a white coat effect.*

The mean left ventricular mass index in the 147 patients was 109 ± 3 g/m^2. There was a significant correlation ($P < .01$) between the left ventricular mass index and the systolic blood pressure readings taken by the (special) family physician (r = 0.27), nurse (r = 0.23), and ambulatory blood pressure recording (r = 0.24). However, the routine family physician systolic blood pressure did not correlate with the left

ventricular mass index (r = 0.06). There was no significant correlation between the left ventricular mass index and diastolic blood pressure for the family physician (r = 0.11), nurse (r = 0.02), or ambulatory blood pressure (r = 0.09).

A white coat effect was more common ($P = 0.05$) in women (39/91) than in men (15/56) based upon the family physician's special office blood pressure readings. Patients with and without a white coat effect received a similar amount of medication, with drug therapy units being 1.7 ± 0.1 and 1.5 ± 0.1, respectively. Left ventricular mass index was also similar for white coat effect (112 ± 4 g/m^2) and non–white-coat-effect patients (108 ± 3 g/m^2).

DISCUSSION

The presence of a white coat effect in a relatively high proportion of treated hypertensive patients in primary care is consistent with surveys of untreated hypertensive patients in the community.[5] It is noteworthy that the most marked white coat effect was observed when readings were taken by the patient's own physician compared to those obtained by a nurse in unfamiliar surroundings in a research unit. As decisions to treat hypertension are based primarily upon the routine office blood pressure, these results suggest that many patients with white coat hypertension may currently be receiving unnecessary drug therapy.

This possibility depends, in part, upon the likelihood that the six family physicians participating in the study are representative of usual care in the community. In preparation for this study, the investigators identified six physicians as being providers of high-quality medical care based upon previous referrals and joint management of a variety of patients with hypertension or heart disease. In addition, the present results are consistent with other studies,[5,12] which have also reported that blood pressure readings taken by physicians are associated with a higher prevalence of white coat hypertension than if readings are taken by nurses. However, in our study there was also a marked difference in the prevalence of a white coat effect between the family physician's routine and special blood pressure readings, with the latter leading to significantly fewer patients having a white coat effect. Thus, physicians seem to be capable of taking a blood pressure measurement which more closely approximates the ambulatory blood pressure value if special attention is given to the measurement techniques.

How do the present findings compare with the results of our previous study[9] on white coat effect in treated hypertensive patients in the tertiary care setting? These patients, who were referred for further management of their hypertension, also exhibited a high prevalence of a white coat effect (73%) when office readings were compared to mean awake ambulatory blood pressure values. In this instance, the office readings were taken by a research nurse or a hypertension specialist, with the mean blood pressure values of the nurse and specialist being similar. The magnitude of the white coat effect was substantially greater in the tertiary care population but this could be due to their relatively high office blood pressure values compared to unselected patients in primary care. Indeed, the presence of a white coat effect is significantly correlated with a higher office systolic blood pressure.

In the only other similar study in the literature, Porchet et al[13] also noted a high prevalence of white coat effect in 38 treated hypertensive patients whose blood pressures were resistant to drug therapy. The mean awake ambulatory blood pressure (151/94) was significantly lower than either office blood pressures recorded by a clinic physician (179/109) or by a research nurse (163/101). As with other studies, the nurses' mean reading was significantly lower than the mean value obtained by the physicians.

Thus, office blood pressure readings measured by specially trained nurses in the research setting may lead to a lower prevalence of white coat effect in treated hypertensive patients in either the community or in the tertiary care setting. However, one caveat merits consideration. Some authors[13] have linked the white coat effect to the treatment setting, such that patients tend to exhibit a higher blood pressure if they are in surroundings where decisions regarding treatment are being made, such as in a specialty hypertension clinic or in their family physician's office. The relative importance of this factor to others, such as a nurse versus physician taking the blood pressure, familiarity with the examiner, and standardized approaches to blood pressure measurement is uncertain. Clearly, how blood pressure is recorded remains important since the prevalence of a white coat effect among our patients decreased from 62% to 37% when family physicians took special versus routine readings.

The different approaches to measuring blood pressure would seem to have direct clinical relevance. Not only may patients with white coat hypertension be put on unnecessary treatment but also target organ damage may not correlate well with office readings in patients with mild to moderate hypertension. For the same level of office blood pressure, patients with left ventricular hypertrophy experience more cardiovascular endpoints compared to those without left ventricular hypertrophy.[15,16] In the present series of treated hypertensive patients in primary care, left ventricular mass index was significantly correlated with systolic blood pressure taken by the family physician (special), nurse, and ambulatory recorder, but not with the family physician's routine office blood

pressure. Indeed, the correlation between left ventricular mass index and the family physician special systolic office blood pressure was very similar to correlations obtained from the nurse and ambulatory data. Office diastolic blood pressure generally does not correlate as well as systolic readings with left ventricular mass index. In our series, the narrow distribution of mostly normal diastolic readings and the use of different antihypertensive agents may also have reduced the likelihood of finding a significant coefficient of correlation between the left ventricular mass index and diastolic blood pressure.

As in other studies of treated and untreated hypertensive patients,[17–19] the women in this primary care population were more likely to exhibit a white coat effect. An analysis of data from 152 treated hypertensive patients in tertiary care has reported an even higher proportion of women with a white coat effect.[20] In a recent metaanalysis of studies on ambulatory blood pressure monitoring, Staessen et al[18] have reported that women are almost twice as likely as men to exhibit higher office versus ambulatory blood pressure readings. Although women tend to be older than men in some of these studies, stepwise regression analysis has shown only gender to be a predictor of the presence of a white coat effect.

What are the implications of finding a high prevalence of white coat effect among treated hypertensive patients in the community? Since patients continue to exhibit a tendency to having a white coat effect despite receiving drug therapy, one can only speculate on how many of these individuals would actually have white coat hypertension if ambulatory blood pressure monitoring had been performed before treatment was initiated. There have already been a number of studies showing that many previously treated hypertensive patients can have therapy withdrawn without again developing persistent hypertension.[21,22] However, none of these studies examined the white coat effect as a possible determinant of success in drug withdrawal.

To clarify this issue, we are currently undertaking a treatment withdrawal study in a treated hypertensive population derived from primary care to see if the ambulatory blood pressure monitor and echocardiogram can define more precisely the extent to which patients in the community may be receiving excessive or unnecessary therapy.

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