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*White coat effect. The influence of the visit in the physician's
consulting room on the arterial blood pressure value*

The transient increase of blood pressure during the traditional measurement made by the physician in ambulatory or hospital conditions has been known for many years and constitutes the greatest obstacle to obtain reliable results. Each case of the increase of blood pressure observed among patients in the presence of medical personnel is defined as the 'white coat effect' (9), whereas chronic increase of blood pressure during the following visits coexisting with normal blood pressure observed outside medical area is called the 'white coat hypertension' (14). The terminology concerning this phenomenon has been recently questioned as wrongly associated only with a person in white coat, which is generally of little significance. A more proper term, more widely defining the conditions in which blood pressure increase occurs, seems to be 'office hypertension' or 'isolated office hypertension'. Despite these reservations 'white coat hypertension' is the term that is colloquial and most frequently used by physicians and patients and also in medical publications (11).

The purpose of this work was to assess the influence of the visit in the consulting room on the value of arterial blood pressure and the frequency of 'white coat effect' and 'white coat hypertension' among consulting room patients. Another aim of the study was to analyse how age, sex, BMI (body mass index) and hypotensive drugs taking influence 'white coat effect'.

MATERIAL AND METHODS

The study was carried out among 209 patients (145 women and 64 men, mean age 58.9) visiting Cardiologic Clinic working during the 8th Social-Scientific Camp in Zwierzyniec (July 2004), organized by the Medical University of Lublin.

In each person three measurements of arterial blood pressure were taken: 15 min before entering the consulting room (measurement 1), during the visit after 10 min (measurement 2) and 15 min after leaving the consulting room (measurement 3). The measurements were made by the same person with a mercury sfigmomanometer in the sitting position, on both arms. The difference between the obtained results was considered insignificant if it did not exceed 5 mmHg for diastolic and systolic pressure. If the difference was major, a further analysis was made from the average results. For each patient the body mass index (BMI) was estimated on the basis of their body mass and height and the medical history concerning hypotensive drugs taking was conducted. The statistical analysis of the obtained results was carried out by means of the t-Student test and the values $p < 0.05$ were considered statistically significant.

RESULTS

Mean systolic and diastolic blood pressure (BP) was $152.6 \pm 24.8/89.6 \pm 12.5$ mmHg in the first measurement, $166 \pm 26.8/98.1 \pm 11.9$ mmHg in the second and $149.9 \pm 23.9/89.7 \pm 11.7$ in the third (Fig. 1). The average increases in SBP and DBP while visiting the consulting room were respectively: 13.5 mmHg (8.85%, $p < 0.00001$) and 8.5 mmHg (9.49%, $p < 0.0001$). The particular changes in measurements among the patients are given in Figures 2 and 3. The effect of white coat was more marked, but not statistically significant, among the women compared with the men, with regard to SBP and DBP (Table 1). The highest mean systolic blood pressure, which was measured (the second measurement), was in the 66–75 age group among the women (175.1 ± 24.8 mmHg) as well as among the men (170 ± 27.4 mmHg). White coat effect in dependence on age and sex is presented in Table 2. The highest mean diastolic BP among women was observed in the 66–75 age group (99.9 ± 10.7 mmHg), whereas among the men – in the 31–45 age group (104.6 ± 10.7 Hg). The maximum increase in BP in the consulting room compared with the first measurement was 65 mmHg (SBP) and 40 mmHg (DBP) among women, and among the men 50 and 23 mmHg, respectively. Among patients who had been previously diagnosed to have hypertension and claimed to use the treatment, the average BP taken in the consulting room was higher compared with patients without antihypertensive drugs, especially in case of SBP (Fig. 4). As much as 13% of patients, being treated due to hypertension, had abnormal BP during the visit and normal outside the consulting room. The mean values of systolic BP increases along with the value of BMI (Fig. 3). The highest values are found in the patients with BMI of at least 30 (overweight according to WHO). Mean BMI was 29 ± 5.4 kg/m² in the study group. The white coat effect was the highest in the 25–30 BMI compartment. Only 23.3% of patients had normal BP during the visit as well as outside the consulting room. The percentage of patients with raised BP ($>140/90$ mmHg) in all measurements was 65.3%. Abnormal BP in the consulting room but normal before and after the visit was observed in 11.4% of the study group.

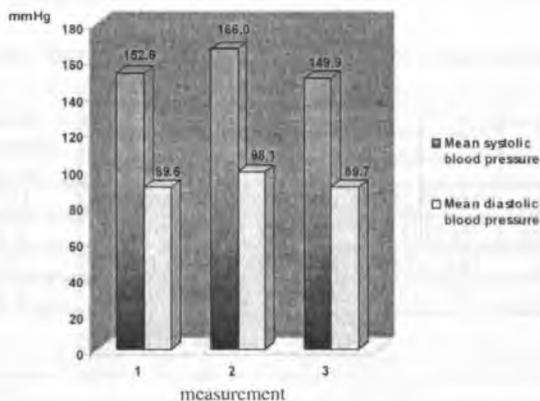


Fig. 1. Mean values of arterial blood pressure before entering to the consulting room (measurement 1), in the consulting room (measurement 2), and after leaving the consulting room (measurement 3)

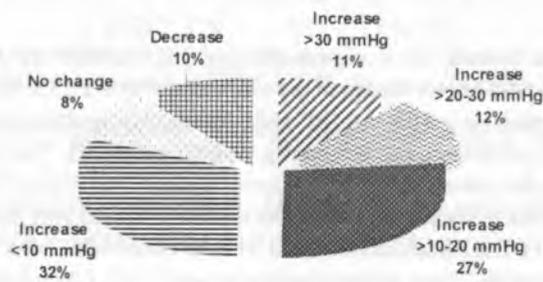


Fig. 2. Distribution of changes of arterial systolic blood pressure in the consulting room in relation to values before entering the consulting room

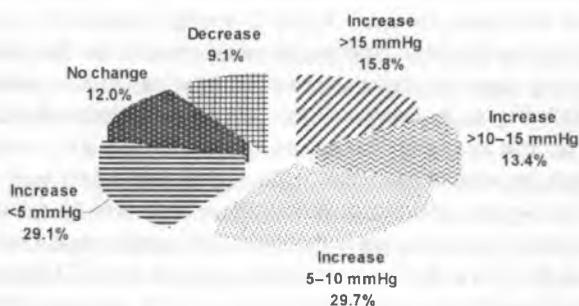


Fig. 3. Distribution of changes of arterial diastolic blood pressure in the consulting room in relation to pressure before entering the consulting room

Table 1. Mean values of arterial blood pressure and the white coat effect' among the men and women

Sex	Arterial blood pressure	Measurement 1 (mmHg)	Measurement 2 (mmHg)	Measurement 3 (mmHg)	Result of meas. 2-1 (mmHg)	Result of meas. 2-3 (mmHg)
Women n=145	systolic	154.5±24.9	168.2±26.6	151.6±24.3	13.7	16.6
	diastolic	89.5±11.9	98.8±12.7	89.9±11.4	9.3	8.9
Men n=64	systolic	148.3±24.1	161.1±26.7	146.1±22.5	12.8	15.0
	diastolic	89.7±13.9	96.6±13.0	89.2±12.5	6.9	7.4

Table 2. Differences between the measurement 2 and 1 (white coat effect) according to the age

Age (years)	Women			Men		
	n	increase in systolic BP (mmHg)	increase in systolic BP (mmHg)	n	increase in diastolic BP (mmHg)	increase in diastolic BP (mmHg)
Before 30	8	7.9	8.8	6	10.0	9.0
31-45	9	14.4	6.6	6	8.3	5.0
46-55	33	16.1	10.5	18	9.2	6.5
56-65	24	12.0	8.3	13	15.0	3.8
66-75	52	15.7	10.4	17	17.9	9.3
Above 75	19	11.3	6.4	4	11.9	6.3

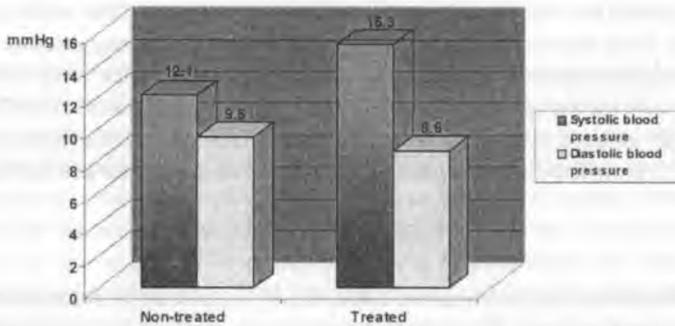


Fig. 4. Differences of mean values of arterial blood pressure in the consulting room and before entering the consulting room (the white coat phenomenon)

Table 3. Mean values of arterial blood pressure and the 'white coat effect' in particular compartments of BMI

BMI (kg/m ²)	Arterial blood pressure	Measurement 1 (mmHg)	Measurement 2 (mmHg)	Measurement 3 (mmHg)	Result of meas. 2-1 (mmHg)	Result of meas. 2-3 (mmHg)
< 25 n = 49	systolic	141.6±24.5	155.2±28.9	139.0±23.7	13.6	16.2
	diastolic	85.7±11.4	93.1±12.1	85.4±10.2	7.3	7.7
> = 25-30 n = 76	systolic	152.3±24.2	168.6±26.7	150.7±22.9	16.3	17.9
	diastolic	87.9±10.9	97.2±11.2	88.8±10.4	9.4	8.4
> = 30 n = 84	systolic	159.2±23.3	170.0±23.8	155.6±22.7	10.8	14.4
	diastolic	93.4±13.5	101.8±13.5	93.0±12.7	8.5	8.8

DISCUSSION

On the basis of the study statistically significant increases in systolic and diastolic BP in the consulting room with regard to measurements taken before and after the visit were found. The 'white coat effect' was observed in about 80% (82% for systolic and 79% for diastolic BP). It seems that the psychological conditions associated with a visit to the doctor and vasoconstriction resulting from the stimulation of the sympathetic nervous system are underlying this phenomenon (8). A practical conclusion can be drawn confirming the usefulness of measuring blood pressure, if it is possible, before entering the consulting room and encouraging patients to take measurements on their own. 'Self-measurements' comprise measurements taken at home or away from home, especially at work. In the world medical literature there are more and more publications showing a higher reliability of 'self-measurements' and their usefulness in routine medical practice (13) as well as a higher correlation between blood pressure values and the presence of organ injury while measurements are performed by a patient (10). The promising results of Japanese researchers indicate a greater dependence between mortality and blood pressure value obtained by self-measurements (4). This opinion, however, is not shared by some other researchers (12). The white coat effect a bit more frequently, but insignificantly, concerned women and people treated with hypotensive drugs, which is consistent with observations of other researchers (2). In our material, in about 13% of hypertension treated patients the presence of the 'white coat effect' would probably cause diagnosis of drug refractoriness because of high values of blood pressure in a consulting room and normal values away from it. So far it has not been established which values of arterial pressure measured outside

medical areas should be considered normal (3). In some publications the 'white coat effect' has been defined as 'false hypertension' in order to emphasize its clinical insignificance and reveal the effects of unnecessarily applied treatment (5). In the light of research the white coat effect should not be ignored and should not be synonymous to a harmless phenomenon (1, 6, 7). The existing controversy over prognostic value of the white coat hypertension will inevitably initiate further study, which will prospectively assess the occurrence of the cardiac events and mortality.

CONCLUSIONS

A visit in the consulting room causes a statistically significant increase in arterial systolic and diastolic blood pressure. It indicates the necessity of more frequent measurements of blood pressure away from medical areas in clinical practice.

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SUMMARY

The transient increase of blood pressure during traditional measurement made by a physician in ambulatory or hospital conditions has been known for many years and constitutes the greatest obstacle to obtain reliable results. Each reaction in the increase of blood pressure observed among patients in the presence of medical personnel is defined as the 'white coat effect'. The purpose of this work was to assess the influence of the visit in the consulting room on the value of arterial blood pressure and the frequency of the 'white coat effect' among cardiological clinic patients. Another aim of the study was to analyse how age, sex, BMI and taking hypotensive drugs influences the 'white coat effect'. The data were obtained during the 8th Social-Scientific Camp in Zwierzyniec (July 2004). The study included 209 persons (145 women and 64 men). In each person the blood pressure was measured three times: before entering the consulting room, during the visit and after leaving the consulting room. The BMI was estimated and the medical interview concerning antihypertensive therapy was carried out in each case. The data were analysed by means of the t-Student test.

Mean systolic and diastolic blood pressure (BP) was $152.6 \pm 24.8/89.6 \pm 12.5$ mmHg in the first measurement, $166 \pm 26.8/98.1 \pm 11.9$ mmHg in the second and $149.9 \pm 23.9/89.7 \pm 11.7$ in the third. The average increases in SBP and DBP while visiting the consulting room were respectively: 13.5 mmHg (8.85%, $p < 0.00001$) and 8.5 mmHg (9.49%, $p < 0.0001$). The effect of white coat was more marked among the women and among the patients taking antihypertensive drugs, with regard to SBP and DBP. The white coat effect was the highest in the 25–30 BMI compartment. A visit in the consulting room causes a statistically significant increase in arterial systolic and diastolic blood pressure. It indicates the necessity of more frequent measurements of blood pressure away from medical areas in clinical practice.

Efekt „białego fartucha”.

Wpływ wizyty w gabinecie lekarskim na wartość ciśnienia tętniczego krwi

Przejściowy wzrost ciśnienia tętniczego krwi w czasie tradycyjnego pomiaru wykonywanego przez lekarza w warunkach ambulatoryjnych lub szpitalnych jest znany od wielu lat i stanowi największą przeszkodę w uzyskaniu wiarygodnego wyniku. Każda reakcja presyjna obserwowana u pacjenta w obecności personelu medycznego jest określana mianem efektu białego fartucha. Celem pracy była ocena wpływu wizyty w gabinecie lekarskim na wartość ciśnienia tętniczego krwi oraz ocena częstości występowania „efektu białego fartucha” u pacjentów gabinetu kardiologicznego. Dane służące do opracowania pracy uzyskano podczas VIII Studenckiego Obozu Społeczno-Naukowego (Zwierzyniec, lipiec 2004). U każdego z 209 pacjentów (145 kobiet i 64 mężczyzn) dokonano trzech pomiarów ciśnienia: przed wejściem do gabinetu lekarskiego, w trakcie wizyty i po wyjściu z gabinetu. U każdego pacjenta obliczono wskaźnik BMI oraz przeprowadzono wywiad lekarski co do leczenia hipotensyjnego. Analizę statystyczną różnic przeprowadzono testem t-Studenta. Obliczono, że w badanej grupie średnie ciśnienie tętnicze skurczowe i rozkurczowe krwi wyniosło odpowiednio: w pierwszym pomiarze: $152,6/89,6$ mmHg, w drugim: $166/98,1$ mmHg, w trzecim: $149,9/89,7$. Otrzymane średnie wzrosły ciśnienie skurczowego ($p < 0,00001$) i rozkurczowego ($p < 0,0001$) w gabinecie wyniosły odpowiednio 13,5 mmHg (8,85%) i 8,5 mmHg (9,49%). Efekt białego fartucha był bardziej wyraźny u kobiet i osób przyjmujących leki hipotensyjne. Dotyczył on ciśnienia skurczowego i rozkurczowego. Efekt białego fartucha był najwyższy w przedziale BMI od 25 do 30 kg/m². Wizyta w gabinecie lekarskim powoduje istotny statystycznie wzrost ciśnienia skurczowego i rozkurczowego u większości pacjentów. Wskazuje to na potrzebę częstszego stosowania w praktyce klinicznej pomiarów ciśnienia poza gabinetem lekarskim.