Office and 24-h ambulatory blood pressure control by treatment in general practice: the 'Monitoraggio della pressione ARteriosa nella medicina TErritoriale' study

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Background **Guidelines recommend that blood pressure (BP) should be lowered in hypertensive patients to prevent cardiovascular accidents. Management of antihypertensive treatment by general practitioners is usually based on office measurements, which may not allow an assessment of BP control over 24 h, which requires ambulatory BP monitoring (ABPM) to be implemented. This is rarely done in general practice, and limited information is available on the consistency between the evaluations of the response to treatment provided by office measurement and by ABPM in this setting.**

Aim **To assess concordance between office BP measurements and ABPM-based estimates of hypertension control in a general practice setting.**

Design of study **Prospective, comparative between techniques.**

Setting **General practice.**

Methods **Seventy-eight general practices, representative of all Italian regions, participated in this study by recruiting sequential hypertensive adults on stabilized treatment, who were subdivided into even groups with office BP, respectively, controlled or noncontrolled by treatment. In each individual, ABPM was applied by the general practitioner after appropriate training, and 24-h ABP values were defined as controlled or not according to current guidelines. Concordance between office and ABPM evaluation of BP control was assessed with κ statistics. Positive and negative predictive values of office measurement versus ABPM were estimated.**

Results **Between July 2005 and November 2006, 190 general practitioners recruited 2059 hypertensive patients based on office BP measurements; in 1728 patients, a 24-h ABPM was performed, yielding 1524 recordings considered as valid for further analysis. The agreement between the assessment of BP control by office measurement and by ABPM was poor ($\kappa = 0.120$), with office measurements showing a satisfactory positive predictive value (0.842) and a poor negative predictive value (0.278); the situation was worse in patients with three or more among the following features: male sex, age of at least 65 years, alcohol consumption, diabetes, and obesity (negative predictive value = 0.149).**

Conclusion **In general practice, the agreement between assessment of BP control by treatment provided by office and ambulatory BP measurements is better in patients of 'uncontrolled' office BP than in 'controlled' office BP patients. This emphasizes the need for the larger use of out-of-office BP monitoring in a general practice setting, in particular, in patients considered as 'controlled' during consultation.** *J Hypertens* **28:910–917 © 2010 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

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Abbreviations: ABPM, ambulatory BP monitoring; BP, blood pressure; NPV, negative predictive value; PPV, positive predictive value

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Introduction

Current hypertension guidelines recommend blood pressure (BP) to be satisfactorily 'controlled' to achieve cardiovascular protection, both in primary and secondary prevention. This implies the achievement of the identified BP targets, currently set at levels below 140/90 mmHg in the office and below 125/80 mmHg over the 24 h [1–3]. General practitioners are expected to play a major role in the attempt to achieve BP normalization in hypertensive patients, but the results of their intervention are often reported as unsuccessful, at least in Italy [3,4]. Furthermore, focus of general practitioners is, in most cases, only on office BP measurements to estimate the degree of hypertension control [5],

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regardless of the increasing evidence on the advantages carried by use of 24-h ambulatory BP monitoring (ABPM) in this context [6,7] and of the reports on the different BP thresholds to be considered with this approach in relation to cardiovascular risk [8–11]. Only a limited proportion of hypertensive patients, however, are managed also by considering the information carried by ABPM, which is usually applied and interpreted by cardiologists without the direct involvement of the general practitioner [5].

Only a few studies [12–14] have addressed the concordance between office and ABPM assessment of hypertension control, focusing in most cases on the evaluation of how often patients considered not controlled by the general practitioner were instead controlled according to ABPM, with the aim being to reduce the costs of hypertension management. This perspective is based on the hypothesis that office BP measurements may overestimate uncontrolled hypertension due to a possible 'white-coat effect' [15] or because patients are attending an unfamiliar environment [16], a possibility apparently confirmed in previous studies [7,12–14].

Misclassification of hypertensive patients due to the influence of a 'white-coat hypertension' might indeed result in overtreatment of patients at relatively limited risk. However, the data obtained from large cohorts seen by general practitioners in Italy [3,4] and the lower BP thresholds for hypertension diagnosis recommended for ABP data [8] seem rather to suggest the occurrence of an opposite phenomenon, that is, a high number of hypertensive patients being inadequately managed because of insufficiently aggressive protocols, thus remaining at high risk of cardiovascular and cerebrovascular accidents.

We therefore deemed it appropriate to experimentally investigate, in Italian practices, the extent of agreement between the classification of BP control based on conventional clinic measurements and that derived from ABPM to explore whether a more systematic use of ABPM might be needed for the appropriate management of hypertension by the general practitioner.

Methods

Participants and data collection

One hundred ninety general practicioners distributed over the Italian territory agreed to participate in this study. All participating doctors were trained on how to properly perform ABPM and were informed on its value in the management of hypertension through educational courses before entering the study.

Each participating physician recruited a minimum of six consecutive hypertensive patients on stabilized antihypertensive treatment for at least 6 months, who were either regarded as well controlled (50%) or not controlled by treatment according to the office BP measurement obtained over the last three visits.

Exclusion criteria were the presence of atrial fibrillation, any severe systemic or psychiatric disease majorly affecting patients' health status, or both, or their inability to reliably perform a 24-h ABP recording.

For each participant who agreed in writing to participate after receiving adequate information, demographic and clinical data were collected (age, sex, date of first diagnosis of hypertension, history of acute coronary syndrome, history of stroke/transient ischemic attack, presence of hypercholesterolaemia, hypertriglyceridaemia, diabetes mellitus, and peripheral arterial disease, as recorded in the practice file; BMI, waist circumference, alcohol consumption, and smoking habits recorded at visit). Office BP according to the usual practice procedures was recorded at the time of the visit in the seated position, together with information on the current antihypertensive therapy and on any other therapy prescribed. As mentioned above, the patient was then classified by the attending physician as having a 'controlled' or 'noncontrolled' hypertension based on the average of the BP values obtained during last three doctor's visits.

Subsequently, each patient performed a 24-h ABPM, making use of the validated A&D TM 2430 device [11]. Measurements were programmed to be taken every 15 min during daytime and every 30 min during the night-time. The ABPM device was applied in the physician's office. The ABPM file, as well as the file including clinical data, was anonymously transferred by each doctor to a Core center hosting the study database, using a validated secure proprietary internet technique (Hypernet).

Data analysis

Data were analysed by an independent CRO, Hyperphar Group (Milan, Italy), using SPSS, version 14, for Windows (SPSS Inc., Chicago, Illinois, USA), after checking the quality of each ABP recording according to the requirements issued by the Italian Society of Hypertension [17] and by the European Society of Hypertension working group on BP monitoring [9]. Patients were classified as having ABP controlled based on the current guidelines (average of the daytime awake period <135/85 mmHg and average of nocturnal sleep time <120/70 mmHg). Daytime and night-time periods were defined based on wide fix intervals (07:00–22:00 h, daytime; 22:00–07:00 h night-time). ABP values higher than suggested thresholds were taken as to indicate uncontrolled ABP [8]. Usual descriptive statistics were used to analyse the study data; comparisons between subgroups were performed with the chi square test (polychotomous nominal), Cochran–Mantel–Haenszel test of the equality of odds ratios (dichotomous nominal), Mann–Whitney *U*-test (continuous variables with nonhomogeneous

Table 1 Demographic and lifestyle profile of the sample

Variable	Hypertension controlled ($N=894$)	Hypertension not controlled ($N=874$)	Total ($N=1768$)	Statistics
Sex, *n* women (%)	453 (50.7)	472 (54.0)	925 (52.3)	0.161[g]
Ethnicity, *n* white (%)[a]	889 (99.4)	866 (99.1)	1755 (99.3)	0.386[g]
Age (years), mean±SD [range]	60.6 ± 11.8 [19–93]	61.5 ± 12.2 [26–98]	61.1 ± 12.0 [19–98]	0.120[h]
Duration of hypertension (months), mean ± SD [range]	84.5 ± 68.3 [6–485]	92.6 ± 74.3 [6–543]	88.5 ± 71.4 [6–543]	0.033[i]
BMI (kg/m^2), mean ± SD [range][b]	27.4 ± 4.0 [14.6–44.4][e]	28.1 ± 4.5 [16.4–47.7][f]	27.7 ± 4.3 [14.6–47.7]	<0.001[i]
Obesity, *n* obese (%)[b]	208 (23.7)[e]	258 (30.4)[f]	466 (27.0)	0.002[g]
At risk from waist circumference[c]	367 (48.1)	414 (56.4)	781 (52.2)	0.001[g]
Active smoking, *n* (%)[d]	120 (13.3)	136 (15.8)	256 (14.7)	0.197[g]
Alcohol consumption, >2 U/day, *n* (%)[e]	38 (4.4)	50 (5.9)	88 (5.1)	0.141[g]
Nonantihypertensive therapy, *n* (%)	424 (47.4)	452 (51.7)	876 (49.5)	0.071[g]
Number of nonantihypertensive drugs, mean ± SD [range][f]	1.9 ± 1.2 [1–8]	1.9 ± 1.2 [1–9]	1.9 ± 1.2 [1–9]	0.809[h]

[a] Others, including two Asiatic, two African, nine Hispanic. [b] Obese: ≥30.0 kg/m^2; 17 controlled missing, 23 noncontrolled missing. [c] At risk: >88 cm if woman, >102 cm if man; 133 controlled missing, 140 noncontrolled missing. [d] Fourteen controlled missing, 16 noncontrolled missing. [e] Twenty-two controlled missing, 31 noncontrolled missing. [f] Only among those taking at least one; most frequent: serum lipid reducing agents (19.6% of patients), antithrombotic agents (18.2%), and drugs used in diabetes (12.7%). [g] Cochran–Mantel–Haenszel test for the equality of the odds ratio. [h] Unpaired *t*-test not assuming equality of variances. [i] Mann–Whitney *U*-test.

variances), and *t*-test (continuous variables with homogeneous variances). The analyses of agreement between techniques were performed using κ statistics; positive and negative predictive values (PPV and NPV) were computed using the classification based on ABPM as reference standard and office BP measurement as test technique. All reported *P* values are two-tailed and have descriptive value only.

The sample size was set at approximately 2000 patients, with 1500 valid ABPM recordings being required to estimate with a power of 95% and a β value of less than 0.05, with a degree of discordance between measures of 1% or more.

The study was performed in compliance with the Declaration of Helsinki, and the protocol, information, and consent procedures were approved by the Ethics Committees of the participating institutions. Participating doctors were trained and certified by the Italian Society of General Practice and the European School of General Practice. The study Steering Committee included the authors of this paper, and was responsible for the scientific reliability of the procedures.

Results

Between 1 July 2005 and 27 November 2006, 190 practicioners recruited 2059 patients: 27 physicians recruited four or less patients, 124 recruited 5–10 patients, and 39 recruited at least 11 patients. Overall, data of 291 patients were excluded from analysis because these patients were unable to provide all data required by the protocol (14 did perform ABPM and were considered in the safety section). ABPM was performed in 1768 patients, with a valid 24-h ABP profile being obtained in 1524 of them.

Among the 1768 patients included, 894 (50.6%) were reported as 'controlled'; the remaining ones as 'not controlled' based on office BP. Table 1 summarizes the demographic and lifestyle profile of these patients and Table 2 summarizes their medical history and antihypertensive medications. As expected, patients with noncontrolled hypertension included individuals with

Table 2 Medical history and antihypertensive medications

	Hypertension controlled ($n=894$)	Hypertension not controlled ($n=874$)	Total ($n=1768$)	Statistics
History of acute coronary syndrome, *n* (%)	64 (7.2)	66/874 (7.6)	130 (7.4)	0.752[d]
History of stroke/TIA, *n* (%)	40 (4.5)	38/874 (4.3)	78 (4.4)	0.897[d]
Hypercholesterolaemia, *n* (%)	305 (34.5)[a]	352 (40.4)[b]	660 (37.4)	0.011[d]
Hypertriglyceridaemia, *n* (%)	131 (14.7)[b]	178 (20.4)[b]	309 (17.5)	0.002[d]
PAD, *n* (%)	20 (2.2)[c]	34 (3.9)[a]	54 (3.0)	0.046[d]
Diabetes, *n* (%)	101 (11.3)	145 (16.6)	246 (13.9)	0.001[d]
Diuretics, *n* (%)	380 (42.5)	428 (49.0)	808 (45.7)	0.006[d]
ACE-inhibitors, *n* (%)	409 (45.7)	388 (44.4)	797 (45.1)	0.567[d]
Beta-blockers, *n* (%)	264 (29.5)	299 (34.2)	563 (31.8)	0.035[d]
AT-II blockers, *n* (%)	257 (28.7)	289 (33.1)	546 (30.9)	0.050[d]
Ca antagonists, *n* (%)	228 (25.5)	304 (34.8)	532 (30.1)	<0.001[d]
Alpha-blockers, *n* (%)	76 (8.5)	93 (10.6)	169 (9.6)	0.127[d]
Therapeutic classes in use, mean ± SD [range]	1.81 ± 0.86 [1–5]	2.06 ± 1.01 [1–6]	1.93 ± 0.94 [1–6]	<0.001[e]
Total daily units, mean ± SD [range]	1.90 ± 0.96 [1–6]	2.17 ± 1.11 [1–7]	2.03 ± 1.05 [1–7]	<0.001[e]
Last office SBP recorded, mean ± SD [range]	137.0 ± 13.3 [97–190]	151.2 ± 14.9 [80–210]	144.0 ± 15.8 [80–210]	<0.001[f]
Last office DBP recorded, mean ± SD [range]	82.4 ± 8.5 [50–118]	89.2 ± 9.5 [50–140]	85.8 ± 9.6 [50–140]	<0.001[f]
Last office HR recorded, mean ± SD [range]	73.7 ± 9.3 [47–115]	75.4 ± 9.5 [50–120]	74.6 ± 9.5 [50–120]	0.001[f]

ACE, angiotensin-converting enzyme; AT, anti-thrombin; HR, heart rate; PAD, peripheral arterial disease; TIA, transient ischemic attack. [a] Two missing information. [b] Three missing information. [c] One missing information. [d] Cochran–Mantel–Haenszel test for the equality of the odds ratio. [e] Mann–Whitney *U*-test. [f] *t*-test.

Table 3 Ambulatory blood pressure monitoring data

	Controlled ($n=763$)	Noncontrolled ($n=761$)	Total ($n=1524$)	Statistics
Mean 24-h SBP	132.7 ± 12.8 [101.7–230.3]	139.5 ± 14.3 [104.2–225.2]	136.1 ± 14.0 [101.7–230.3]	<0.001[c]
Mean 24-h DBP	78.2 ± 6.9 [57.2–102.0]	80.8 ± 8.5 [60.4–110.9]	79.5 ± 7.9 [57.2–110.9]	<0.001[c]
Mean 24-h HR	71.7 ± 8.5 [47.0–101.7]	71.6 ± 8.8 [49.2–102.9	71.6 ± 8.7 [47.0–102.9]	0.786[b]
Mean daytime SBP	136.0 ± 13.0 [103.2–223.8]	142.8 ± 14.7 [103.1–241.9]	139.4 ± 14.3 [103.1–241.9]	<0.001[c]
Mean daytime DBP	80.4 ± 7.6 [59.0–106.6]	83.2 ± 9.2 [60.1–111.4]	81.8 ± 8.6 [59.0–111.4]	<0.001[c]
Mean daytime HR	74.5 ± 9.2 [49.2–107.6]	74.2 ± 9.4 [51.6–107.4]	74.3 ± 9.3 [49.2–107.6]	0.471[b]
Mean night-time SBP	121.0 ± 17.7 [82.4–226.3]	127.4 ± 19.1 [85.5–220.4]	124.2 ± 18.7 [82.4–226.3]	<0.001[c]
Mean night-time DBP	70.1 ± 9.3 [48.0–108.0]	72.4 ± 10.1 [48.1–107.8]	71.2 ± 9.7 [48.0–108.0]	<0.001[c]
Mean night-time HR	62.3 ± 8.6 [38.5–98.5]	62.6 ± 9.2 [36.3–99.9]	62.4 ± 8.9 [36.3–99.9]	0.416[b]
Nocturnal SBP drop[a]	15.0 ± 14.7 [−55.1 to +69.2]	15.5 ± 16.3 [−66.3 to +65.0]	15.2 ± 15.5 [−66.3 to +69.2]	0.463[c]
Nocturnal DBP drop[a]	10.3 ± 9.1 [−18.9 to +38.8]	10.9 ± 9.4 [−34.6 to +44.2]	10.6 ± 9.2 [−34.6 to +44.2]	0.229[b]
Nocturnal HR drop[a]	12.3 ± 7.3 [−14.4 to +37.3]	11.6 ± 7.8 [−18.9 to +35.1]	11.9 ± 7.5 [−18.9 to +37.3]	0.063[b]

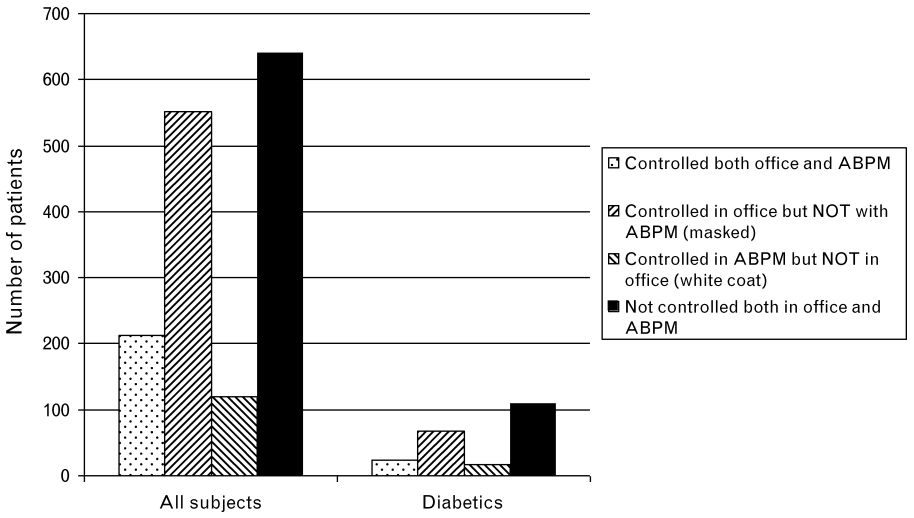
Data are given in mean ± SD [range]. HR, heart rate. [a] Difference between mean daytime average and mean night-time average; negative means an increase. [b] Unpaired *t*-test not assuming equality of variances. [c] Mann–Whitney *U*-test.

significantly greater body weight and waist circumference than those with controlled hypertension. Furthermore, they had a significantly longer history of hypertension; higher proportion of concurrent diseases, especially diabetes; and were receiving significantly more antihypertensive agents (especially, diuretics, β-blockers, and Ca antagonists).

In 244 patients, the 24-h ABP recording was rated as not valid. High-quality ABPM in a general practice setting could thus be obtained in 1524 out of 1768 patients in a per protocol analysis or in 1524 out of 1970 patients according to an intention-to-treat approach, by including patients who should have performed ABPM (seen at the office, no recorded exclusion criteria) but who did not. The feasibility of ABPM in general practice setting can, therefore, be estimated as ranging between 77.4% [95% confidence interval (CI) = 75.4–79.2] and 86.2% (95% CI = 84.5–87.8). The proportion of valid ABP recordings was similar between controlled (85.3%; 95% CI = 82.8–87.6) and noncontrolled patients (87.1%; 95% CI = 84.6–89.2%; $P = 0.294$, Cochran–Mantel–Haenszel test). Overall, only 332 out of 1524 valid ABP recordings identified a 'controlled' hypertension over 24 h. Out of the 1192 recordings 'not controlled' for ABP, 749 (62.8%) were not controlled during both day and night; 226 (19.0%) were not controlled during the night but controlled during the day, and 217 (18.2%) were not controlled during the day but controlled during the night (data not shown). Table 3 summarizes the ABPM data.

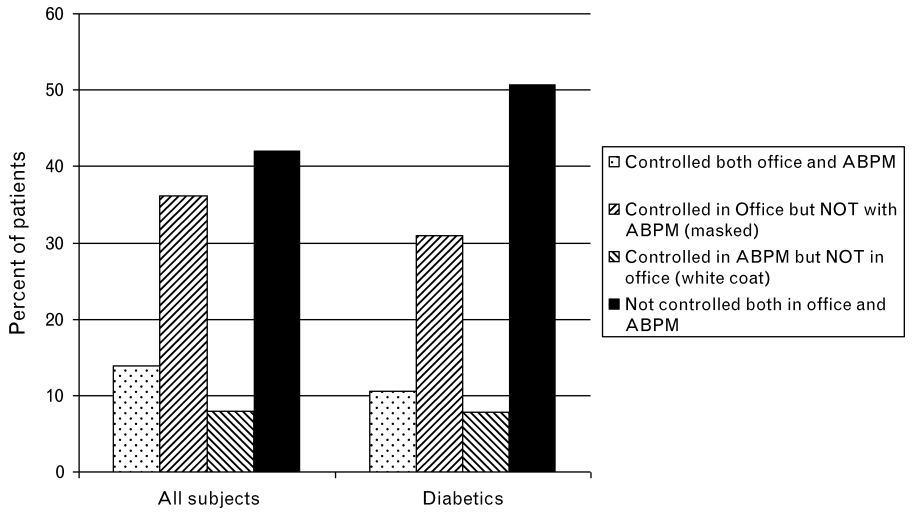
The agreement between office and ABPM classification of BP control was overall poor ($\kappa = 0.120$; Figs 1 and 2). A patients defined as 'not controlled' during the visit by the attending physician had more than 80% probability to be found 'not controlled' also by 24-h ABPM. On the contrary, a patient defined as 'controlled' by the attending physician had more than 70% probability to be found 'not controlled' by ABPM. Among diabetic patients, the latter proportion increased to almost 75% by considering the

Fig. 1



Agreement (all patients) between office and ambulatory blood pressure monitoring classification of blood pressure control. ABPM, ambulatory blood pressure monitoring.

Fig. 2



Agreement (percent) between office and ambulatory blood pressure monitoring classification of blood pressure control. ABPM, ambulatory blood pressure monitoring.

same 24-h ABP normalcy cut-off value as in nondiabetic patients, in absence of more precise guidelines.

Taking 24-h ABP as reference standard, the office measurement had quite a good PPV (0.842) but a poor NPV (0.278). Among diabetic patients, the PPV of the office measurement remained high (0.866) but the NPV decreased to 0.256.

Specific subgroups of patients, in whom a particularly low NPV of office BP measurements might be expected, were identified with the aim of defining conditions in which it would be appropriate to systematically perform 24-h ABPM. On the basis of the estimates reported in Table 4, performance of 24-h ABPM appeared indicated mostly in patients considered 'controlled' by the general practitioner, of male sex, at least 65 years of age, drinking more than 2 U/day of alcohol, obese, or with diabetes. Among the patients exhibiting three or more among these five characteristics, the PPV of office BP was 0.914 and the NPV was 0.149. The patients in this subgroups represented approximately 12% of the monitored population of hypertensive patients on treatment.

Safety

In the present study, 72 patients out of the 1842 who performed ABPM (of whom 1768 analysed and 74 protocol violators) prematurely interrupted the recording (4.0%; 95% CI = 3.1–5.0), in 51 of them because of intolerance or discomfort, in 17 because of technical problems, and in four because of refusal to complete the 24-h recording. The total number of undesired reactions, including those not ending in premature test interruption, amounted to 224 events in 204 patients (11.1%; 95% CI = 9.7–12.6). These events included effects of the compressive action of the cuff (expressed as pain, local discomfort, topical reactions from swelling to rash, local haematomas/ecchymoses, and hand paraesthesias: 163 events), disturbances during sleep (54 events), and anxiety or general discomfort associated with the procedure (seven events). The intensity was reported as mild for 120 events, moderate

Table 4 Positive and negative predictive value of office blood pressure measurement by subgroup

Factor	Level	PPV	NPV
All patients		0.482	0.278
Age (years)	<55	0.833	0.290
	55–64	0.845	0.304
	≥65	0.847	0.248
Active smokers	No	0.850	0.286
	Yes	0.800	0.260
Alcohol abusers	No	0.842	0.282
	Yes	0.911	0.097
Sex	Men	0.901	0.243
	Women	0.788	0.315
Hypercholesterolaemia	No	0.860	0.254
	Yes	0.816	0.324
Hypertriglyceridaemia	No	0.829	0.280
	Yes	0.892	0.275
History of CHD	No	0.839	0.278
	Yes	0.877	0.271
History of stroke/TIA	No	0.841	0.277
	Yes	0.871	0.294
PAD	No	0.838	0.273
	Yes	0.966	0.500
Diabetes	No	0.838	0.281
	Yes	0.866	0.256
Obese	No	0.834	0.288
	Yes	0.865	0.251
Risk from abdominal fat	No	0.853	0.268
	Yes	0.840	0.289
Antihypertensive drugs	1–2	0.853	0.266
	3 or more	0.819	0.321

CHD, coronary heart disease; NPV, negative predictive value; PAD, peripheral arterial disease; PPV, positive predictive value; TIA, transient ischemic attack.

for 80, and severe for 17. The 17 reactions classified as severe led to premature cuff removal by the patients (except in three patients) and included pain at compression (in seven), sleep disturbances (in four), topical reactions (in two), hand paraesthesias (in two), and anxiety and discomfort (in one each). Corrective actions by the physician (usually consisting in repositioning of the cuff) were rarely taken because the onset of the above reaction was normally not immediate.

Discussion

This study is, to our knowledge, the first nationwide evaluation of the concordance between the definition of hypertension control by general practitioners' based on conventional BP measurements and the corresponding definition based on data obtained from 24-h ABPM performed in the same patients. The main result of our study is that patients found not to be controlled by conventional BP measurements at the general practitioner's office were likely to be found so also by 24-h ABPM, whereas patients found controlled by office BP measurements were frequently found not controlled according to ABPM. This discrepancy does not carry only methodological implications but it is also of substantial clinical relevance among high-risk patients who need accurate management of their hypertension.

On theoretical grounds, these findings may lead to the conclusion that hypertensive patients found 'controlled' in the office under antihypertensive treatment should be considered for 24-h ABPM performance by the general practitioner based on the expectation that approximately 66% of the hypertensive population may be found 'not controlled' according to ABPM criteria. This theoretical systematic approach, however, would result in the prescription of a very high number of 24-h ABP recordings with a significant impact on healthcare costs, also taking into account the increasing proportion of hypertensive patients in the population. The findings of our study may offer a practical solution to this difficulty, however. On the basis of the search of possible determinants of the discrepancy between the identification of hypertension control provided by office and ambulatory BP measurements, our data allow the identification of relatively small subgroups of hypertensive patients in whom 24-h ABPM should indeed be performed, aimed at effectively reducing cardiovascular risk. Among hypertensive patients considered as 'controlled' by the general practitioner during the office visit, patients of male sex, aged at least 65 years, alcohol consumers (>2 U/day), with obesity and diabetes would in particular need 24-h ABPM to be performed. This suggestion is based on the fact that, among the patients carrying three or more of these five features, the PPV of office BP, in identifying controlled 24-h ABP values, was 0.914, whereas the NPV was only 0.149. The patients in this subgroup represented approximately 12% of the population of hypertensive patients on treatment included in our study.

An additional finding of our study is related to ABPM application by general practitioners, who appear able to obtain valid 24-h ABP recordings in 85% of hypertensive patients. This performance is not too different from that reported in specialized centres [9]. It has to be acknowledged, however, that this result may not faithfully reflect the performance of the 'average' general practitioner in Italy because doctors participating in this study underwent specific training, which is not usually accessible to all general practitioners.

A direct comparison with previous similar experiences in this regard can hardly be made because of the limited number of studies available on this issue and due to the change in ABPM evaluation criteria introduced by recent ABPM guidelines [8,9,17]. In a much smaller cohort in Ireland (381 patients), 33.8% had a normal BP result on ABPM [18] compared to the 21.8% seen in the present study, a finding that may be explained by methodological differences. Several studies [7,12–14] have been performed to explore the need to reduce treatment intensity on the assumption that office measurements might be affected by a substantial 'white-coat effect'. This condition (i.e. 'noncontrolled' patients in the office found controlled at 24-h ABPM), however, was observed only in 7.9% of patients included in our study, a finding not substantially different from the data reported in the literature in a similar setting [19]. Thus, our study suggests that the condition referred to as 'white-coat hypertension' is infrequently found in general practice, probably because of the relationship between patients and their family doctor is significantly different than that between patients and doctors working in a specialist clinic. Conversely, a 'masked hypertension' condition is more frequently identified in this setting, which emphasizes the need to obtain information on out-of-office BP in a relatively high number of patients. This could be done either through 24-h ABPM performance or through a more frequent implementation of home BP monitoring [20]. Our study was not designed to explore this issue, but the similarities and differences between the information on out-of-office BP provided by home and ABPM is a topic of great interest [21–23], which would, however, require further investigation in future studies.

Conclusion

Our study emphasizes the importance of PPV of office readings in identifying patients with uncontrolled 24-h BP in general practice. Our data, however, also emphasize that the finding of controlled office BP in this setting should be taken with caution because it might not faithfully reflect 24-h BP control in daily life. [24] This calls for a larger use of 24-h ABPM also in clinical practice, and our study offers some indication on the clinical features

that might help identifying those patients in whom implementation of this approach can be particularly useful and may allow a more efficient reduction of BP-related patient's cardiovascular risk.

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Appendix

List of participating general practitioners: Abbate Giuseppe, Agati Riccardo, Alborghetti Ivan, Allasia Bartolomeo, Ammannati Francesco, Antico Romano, Argena Antonio, Baglioni Gregorio, Barone Giovanni, Bellini Felice, Bitetti Rocco, Boncompagni Salvatore, Bonvincini Angelo, Borchi Remo, Boschi Giuseppe, Brancati Ciro, Bressani Anna Maria, Brunelli Brunello, Bruno Lucio Angelo, Bruschelli Carla, Bucigno Fausto, Bufano Carmine, Caccamo Orazio Antonio, Caiello Paola, Calabria Elio, Calcini Silvio, Caligiore Giuseppe, Calzolari Mauro, Campolongo Domenica, Canizzo Diego, Cannelli Bernardo, Cantini Andrea, Capotorto Giuseppe, Caprioli Giuseppe, Carducci Alberto, Caruso Marco, Casarola Sergio, Cecchi Massimo, Ciccone Roberto, Cicconofri Beatrice, Cimignoli Emanuela, Ciotola Pietro, Coletta David, Colomasi Giuseppe, Colosa Giuseppe, Colpani Camilla, Comina Aldo, Condello Domenico, Coppini Bruno, Coppotelli Alberto, Corallo Giovanni, Corrado Carnemolia, Cosima Musci, Crapanzano Andrea, Croce Giuseppe, Curreri Antonio, Dainelli Giuseppe, D'Ambrosio Gaetano, D'Amico Giuseppe, De Bellis Giovanni, De Simone Mario, Dell'Orco Mario Domenico, Dezio Giovanni, Di Giacomo Giovanni, Di Guardo Antonino, Di Natale Massimo, Diaco Goffredo, Dibitetto Nicola, Dolcetti Umberto, Draghini Leonardo, Duranti Giuliana, D'Urso Giuseppe, Ercolino Luigi, Fazio Francesco, Ferrante Tullio, Ferraro Salvatore, Filetti

Giuseppe, Filippi Alessandro, Filippini Giovanni, Finessi Riccardo, Fiorentini Guido, Fiumana Marzio, Fogher Michele, Fontana Francesco, Foppa Luciano, Gabriele Pino, Gadaleta Caldarola Gennaro, Gangi Fabrizio, Gasparin Amedeo, Gazzurra Stefano, Gerace Antonio, Germano Francesco, Germini Fabrizio, Ghezzi Pietro, Giacci Luciano, Gianderico Alberto, Giannone Alfonso, Giardina Giovanni, Graffigna Renato, Grazzini Marcello, Greco Antonietta, Guerra Antonio, Guida Angelica, Iaccarino Patrizia, Ianiro Gabriella, Intorre Luigi, La Greca Giuseppe, La Vecchia Diego, Lamonica Calogero, Laringe Matteo, Leoni Vincenzo, Lo Vullo Antonino, Loci Antonio, Losacco Renato, Maestoso Carmine, Magi Lorenzo, Manlio Judica, Manzoni Giuseppe, Marangio Giovanni, Mascaretti Claudio, Mastriforti Liliana, Maurici Vincenzo, Melani Paolo, Michelini Vittorino, Micillo Enzo Bruno, Milani Monica, Minervino Francesco, Moniaci Felice, Morgana Ignazio, Muratore Angelo, Murolo Nicola G.M., Musso Paolo, Napoli Luigi, Natali Roberto, Natalini Bruno, Nati Giulio, Negri Fabrizio, Nicoli Sergio, Nista Nunzia, Paci Carmelo, Paganelli Libero, Pantaleone Caliandro, Paolini Italo, Papi Giancarlo, Parretti Damiano, Parrini Andrea, Pasculli Domenico, Pasinetti Mariella, Pasqualetto Salvatore, Penna Antonio, Pericoli Roberto, Perrone Angela, Piccinocchi Gaetano, Piccolo Francesco, Piccolo Luigi, Piras Enrico, Pomponi Angela, Portas Gianfranco, Posella Raffaele, Roberto Zelante, Rossi Alessandro, Rossi Sergio, Rossi Carmelo Luciano, Rubicini Giuseppe, Sajeva Giuseppina, Salvio Giuliano, Samani Fabio, Sandullo Antonino, Scotti Aldo, Scrofani Angela, Sergio Claudio, Sessa Aurelio, Shafik Kurtam, Sorbo Edgardo, Spadaro Giorgio, Spampinato Alfio, Stramenga Carlo, Surace Maria Antonietta, Taurisano Maria Chiara, Travaglini Rita, Trombatore Alberto, Urbani Alessandro Maria, Vanni Alberto, Varrica Gaetano, Viola Dario, Virgadaula Giorgia, Vitobello Matteo, Zala Massimo, Zaninelli Augusto, Zuccolo Enzo.