Telemonitoring of 24-Hour Blood Pressure in Local Pharmacies and Blood Pressure Control in the Community: The Templar Project

Stefano Omboni,[1,2,*] Antonio Mancinelli,[1] Franco Rizzi,[1] and Gianfranco Parati;[3,4] on behalf of the TEMPLAR (TEleMonitoring of blood Pressure in Local phARmacies) Project Group

BACKGROUND
The analysis of ambulatory blood pressure monitorings (ABPMs) performed in 639 Italian pharmacies in the context of a telehealth-based service allowed to evaluate the level of blood pressure (BP) control in the community.

METHODS
Twenty-four-hour ABPMs were performed by a clinically validated, automated, upper-arm BP monitor. Recordings were uploaded on a certified web-based telemedicine platform (www.tholomeus.net) and remote medical reporting provided. In each subject, an automatic BP measurement was obtained in the pharmacy and clinical information collected before starting the ABPM.

RESULTS
A total of 20,773 subjects (mean age 57 ± 15 years; 54% females; 28% receiving antihypertensive medications, 31% with any cardiovascular [CV] risk factor) provided valid ABPMs. BP control was poor, but better in ambulatory conditions (24-hour BP <130/80 mm Hg 54% vs. pharmacy BP < 140/90 mm Hg 43%; $P < 0.0001$) and in drug-treated subjects. Sustained normotension was reported in only 28% subjects. Isolated nocturnal hypertension (16%; nighttime BP ≥120/70 mm Hg with normal daytime BP) was more common ($P < 0.0001$) than isolated daytime hypertension (9%; daytime BP ≥ 135/85 mm Hg with normal nighttime BP). Sustained hypertension (43%) was more common in younger males at the lowest CV risk, with daytime hypertension. White-coat hypertension (14%) was more common in females. Masked hypertension was not uncommon (15%) and more often observed in older males with an elevated nocturnal BP.

CONCLUSIONS
A telemedicine-based service provided to community pharmacies may facilitate access to ABPM, thus favoring a more accurate hypertension screening and detection. It may also help describe the occurrence of different 24-hour BP phenotypes and personalize the physician's intervention.

Keywords: ambulatory blood pressure monitoring; blood pressure; blood pressure telemonitoring; hypertension; pharmacy; telehealth; telemedicine

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Properly trained and certified, community pharmacists may support family doctors in the effort of improving blood pressure (BP) control of their patients.[1,2] Team-based care practices including a pharmacist may help expand patient access to screening of hypertension, improve hypertension management, and assure quality of care.[3] The use of telehealth can make the physician–pharmacist collaborative practice more efficient.[4]

The recent introduction in Italian community pharmacies of 24-hour ambulatory blood pressure monitoring (ABPM) with medical telereporting and telecounseling carries the enormous potential of extending a better screening of hypertension to an increasing number of patients. Indeed, ABPM allows to precisely estimate an individual's BP profile and risk and enables the detection of white-coat hypertension and masked hypertension, 2 conditions that cannot be identified by relying solely on isolated office BP measurement.[5]

The TEMPLAR (TEleMonitoring of blood Pressure in Local phARmacies) project, the currently largest Italian telemedicine-based ABPM Registry in the field, was setup to analyze the 24-hour ABPMs performed in community

Correspondence: Stefano Omboni (stefano.omboni@iitelemed.org)

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[1]Clinical Research Unit, Italian Institute of Telemedicine, Varese, Italy; [2]Scientific Research Department of Cardiology, Science and Technology Park for Biomedicine, Sechenov First Moscow State Medical University, Moscow, Russia; [3]Section of Cardiovascular Medicine, Department of Medicine and Surgery, University of Milano-Bicocca, Milan, Italy; [4]Istituto Auxologico Italiano, IRCCS, Department of Cardiovascular, Neural and Metabolic Sciences, S. Luca Hospital, Milan, Italy

*This author takes the responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

pharmacies enabled for this service in accordance with the current Italian regulations. In this report, we present the first results of the study obtained in a very large sample of subjects (>20,000) with the specific purposes of evaluating how a telehealth network involving the pharmacist may be useful to improve the screening of high BP and of verifying which is the actual degree of BP control in the community.

METHODS

Study population

This is an observational, cross-sectional, multicenter study, registered with ClinicalTrials.gov at number NCT03781401 and with the Registry of Patient Registries at number 41818. The project is promoted by the Italian Institute of Telemedicine and endorsed by the Italian Society of Hypertension and the Italian Society of General Practitioners. Consecutive adult subjects (aged ≥ 18 years) of both sexes with guidelines-based clinical indications for ABPM (either treated with antihypertensive drugs or untreated) were recruited. The ABPM was prescribed by the referring family doctor and it was offered to patients by certified Italian community pharmacies. For the purpose of this analysis, a total of 20,773 adult subjects performing valid ABPMs in 639 community pharmacies between October 2010 and December 2017 were considered. The study was conducted according to the principles of the Declaration of Helsinki. Informed consent was obtained from each individual, also for the purpose to use subjects' anonymized data for aggregated analysis, according to current Italian and European data protection code, but no approval from any ethics committee was required because 24-hour ABPMs were performed as part of routine clinical practice and not in the context of a research study. At the time of ABPM fitting or removal, the pharmacist was asked to interview the patient and complete a diary with information about concomitant diseases and treatments. All data were collected prospectively and anonymized before any analysis.

Ambulatory blood pressure measurement

ABPM was performed in all pharmacies according to current guidelines.[5,6] Before being enrolled in the study, all pharmacists received a teaching webinar during which they were trained and certified in the proper use of the ABPM technique and of the telemedicine web-based platform. Each ABPM was recorded on working days and had to start preferably in the morning and to record values for at least 24 hours. BP measurements were performed at intervals of 15–30 minutes with a clinically validated automated electronic upper-arm oscillometric device (Microlife WatchBP 03; Microlife AG, Widnau, Switzerland).[7,8] Cuff sizes appropriate to subject's arm were used and placed on the nondominant arm. Subjects were instructed to keep their arm still and remain motionless during the cuff's automatic inflation. Once the device was fitted, an initial automated BP reading was taken in presence of the pharmacist after 5 minutes of rest in the sitting position with the same device used for ABPM and used as the pharmacy BP reference, considered as a sort of "office" BP. Then, subjects were sent back to their usual activities but were asked to avoid strenuous exercise. They had also to complete a diary in which daily activities, including time of sleep, had to be reported. The subjects were asked to return to the pharmacy 24 hours later to have the device unfitted and the recording terminated.

Web-based telemedicine platform

Data collection was ensured through a clinically validated and certified web-based telemedicine platform (THOLOMEUS, www.tholomeus.net; Biotechmed Ltd., Somma Lombardo, Varese, Italy). Shortly after ABPM device removal, the recording was uploaded on the telemedicine web platform by plugging the BP monitor to the computer through a USB (Universal Serial Bus) cable. ABPM data were automatically processed and a medical report of the test was provided by trained and certified medical specialists and published on the reserved area of the website. If needed, the reporting physicians could contact the pharmacist to provide counseling on patient's management. When uploading the test on the web platform, the pharmacist was asked to enter in the system all the relevant patient's clinical information through the electronic health record tool available on the website.

Statistical analysis

Each ABPM recording was scanned to automatically identify possible artifacts, by applying specific validated editing criteria.[5,6] All measurements not complying with such criteria and not clinically justified were discarded and not included in the analysis. Only ABPMs with (i) at least 70% of the expected number of valid single readings, (ii) at least 20 valid measurements during the day, and (iii) at least 7 valid measurements during the night were included in the analysis.[6] As a result of the selection of valid ABPMs, 20,773 recordings of the 23,807 originally performed were included in the analysis (87.3%). The individual ambulatory systolic blood pressure (SBP) and diastolic blood pressure (DBP) values were averaged to obtain the whole 24-hour mean, the day and night mean (according to individual diaries and actual sleep period) and means for each hour of the recording. BP control was evaluated by computing the proportion of patients with "office-like" hypertension (SBP ≥ 140 mm Hg and/or DBP ≥ 90 mm Hg) and 24-hour hypertension (24-hour SBP ≥ 130 and/or DBP ≥ 80 mm Hg).[5,6] The distribution of BP control within the 24 hours was evaluated by calculating the rate of subjects with isolated daytime hypertension (daytime SBP ≥ 135 and/or DBP ≥ 85 mm Hg with nighttime BP < 120/70 mm Hg) and isolated nighttime hypertension (daytime BP < 135/85 mm Hg with nighttime SBP ≥ 120 and/or DBP ≥ 70 mm Hg).[5,6]

In addition, subjects were categorized according to the concordance between "office-like" and ambulatory BP as sustained normotensive (normal "office-like" + normal 24-hour, daytime, and nighttime BP), sustained hypertensive (elevated "office-like" + elevated 24-hour or daytime or nighttime BP), white-coat hypertensive (elevated "office-like" BP + normal 24-hour, daytime, and nighttime BP), and masked hypertensive (normal "office-like" BP + elevated 24-hour or daytime or nighttime BP).[5,6]

The analysis was performed on the whole-study population and in subgroups according to (i) antihypertensive treatment (untreated vs. treated), (ii) sex (male vs. female), (iii) younger (<65 years) vs. older age (≥65 years), (iv) known cardiovascular (CV) risk factors (treated arterial hypertension, known CV disease, diabetes, or dyslipidemia), and (v) presence of any concomitant diseases. The potential contribution of sex, age, CV risk factors, and concomitant diseases to the achievement of "office-like" and ambulatory BP control was estimated also by stepwise logistic regression analysis.

Main demographic and clinical characteristics were summarized and compared between individual study subgroups by analysis of variance or Chi-square test. The level of statistical significance was kept at 0.05 throughout the study. Data are shown as mean ± SD for continuous variables and as absolute (*n*) and relative (%) frequencies for discrete variables. Data management and analysis were carried out by SPSS, version 20 for Windows.

RESULTS

General characteristics of the study population including subgroups

A total of 20,773 subjects were studied, of which 11,080 (53.3%) enrolled in the northern regions, 6,186 (29.8%) enrolled in the southern regions, and 3,507 (16.9%) enrolled in the central regions of the country. The average age of the population was 57.1 ± 14.6 years (range 18–100 years, with 32.0% of subjects aged 65 years or older) with a slight predominance of females over males (53.8% vs. 46.2%). Overall, 28.2% of the subjects were receiving antihypertensive treatment. Any CV risk factor, any concomitant disease, or any concomitant treatment was reported by 30.7%, 36.0%, and 35.6% of subjects, respectively.

Demographic and clinical characteristics of the specific subgroups are summarized in Table 1.

Pharmacy office and ambulatory BP levels in the whole-study population

As expected, "office-like" SBP/DBP values (137.5 ± 18.2/86.6 ± 12.8 mm Hg) were higher ($P < 0.0001$) than 24-hour average SBP/DBPs (125.0 ± 12.4/76.0 ± 9.0 mm Hg), and daytime average SBP/DBPs (128.8 ± 12.7/79.3 ± 9.6 mm Hg) were higher ($P < 0.0001$) than nighttime average SBP/DBPs (115.1 ± 13.9/67.4 ± 8.9 mm Hg).

"Office-like" hypertension was more common than 24-hour ambulatory hypertension (57.3% vs. 46.2%, $P < 0.0001$). The prevalence of both "office-like" and 24-hour hypertension was larger ($P < 0.0001$) among subjects living in the northern regions of the country (59.0% and 48.3%, respectively) compared to dwellers of central (56.4% and 47.1%) and southern Italy (54.6% and 41.8%).

In the whole-study population, a diagnosis of isolated nocturnal hypertension was more common than that of isolated daytime hypertension (15.7% vs. 9.4%, $P < 0.0001$).

Pharmacy BP and ambulatory BP levels in specific subgroups

As summarized in Table 1, "office-like" and ambulatory SBP and DBP values were higher in subjects not treated with antihypertensive medications, in males, in subjects with no CV risk factors or no concomitant diseases than in the respective counterparts: the only exception was nighttime SBP, which was larger in subjects treated with antihypertensive drugs or displaying any CV risk factor. "Office-like" and ambulatory SBP values were higher and DBP values lower in older than in younger subjects. Line plots of hourly averages in Figure 1 show in detail the between-group differences in ambulatory BPs during the monitoring period.

Office, 24-hour, and isolated daytime hypertensions were significantly ($P = 0.0001$) more common in subjects not treated for hypertension, males, young subjects, and those at low CV risk or with no concomitant diseases (Figure 2). Isolated nocturnal hypertension occurred significantly ($P = 0.0001$) more often in subjects treated with antihypertensive medications, older subjects, and in those at high CV risk or with concomitant diseases, whereas its prevalence did not significantly differ between sexes.

Concordance between pharmacy BP and ambulatory BPs in defining a high BP condition

Sustained normotension was reported in 27.7% of the overall sample, sustained hypertension in 43.3%, white-coat hypertension in 13.9%, and masked hypertension in 15.0%. As shown in Figure 3, sustained normotension was significantly more frequent in treated subjects (in whom it identifies a condition of sustained hypertension control), females, older subjects, and those with concomitant CV risk factors or diseases. Conversely, sustained hypertension was more often observed in untreated subjects (in treated subjects this condition reflecting sustained uncontrolled hypertension), males, younger subjects, and those with no CV risk factors or concomitant diseases.

White-coat hypertension was more likely to be reported by treated subjects (reflecting a condition of white-coat uncontrolled hypertension), females, and those individuals with concomitant CV risk factors or diseases, whereas no significant difference in its prevalence was observed between younger and older subjects. Finally, masked hypertension was more common in treated subjects (in this case representing a condition of masked uncontrolled hypertension), males, older subjects, and individuals with CV risk factors or concomitant diseases.

Determinants of pharmacy and ambulatory BP normality

The most common determinants of elevated 24-hour BP levels were a male sex, a younger age, and the absence of CV risk factors or concomitant diseases (Table 2). An isolated daytime hypertension was more likely to be observed in male subjects with a younger age and no CV risk factors, whereas a nocturnal hypertension was more common in older subjects and in those with CV risk factors.

Table 1. Demographic and clinical characteristics of the whole-study population and of the various study subgroups

	Untreated (*n* = 14,915)	Treated (*n* = 5,858)	*P* value	Male (*n* = 9,605)	Female (*n* = 11,168)	*P* value	Young (*n* = 14,135)	Old (*n* = 6,638)	*P* value	CV risk factors– (*n* = 14,388)	CV risk factors + (*n* = 6,385)	*P* value	Concomitant diseases– (*n* = 13,303)	Concomitant diseases+ (*n* = 7,470)	*P* value
Age (years)	54.7 ± 14.2	63.2 ± 13.6	<0.0001	55.1 ± 14.2	58.8 ± 14.6	<0.0001	49.2 ± 9.7	74.0 ± 6.4	<0.0001	54.5 ± 14.2	62.9 ± 13.6	<0.0001	54.6 ± 14.2	61.6 ± 14.0	<0.0001
Sex															
Male	7,023 (47.1)	2,582 (44.1)	<0.0001	9,605 (100.0)	0 (0.0)	<0.0001	7,065 (50.0)	2,540 (38.3)	<0.0001	6,801 (47.3)	2,804 (43.9)	<0.0001	6,417 (48.2)	3,188 (42.7)	<0.0001
Female	7,892 (52.9)	3,276 (55.9)		0 (0.0)	11,168 (100.0)		7,070 (50.0)	4,098 (61.7)		7,587 (52.7)	3,581 (56.1)		6,886 (51.8)	4,282 (57.3)	
Antihypertensive treatment	0 (0.0)	5,858 (100.0)	<0.0001	2,582 (26.9)	3,276 (29.3)	<0.0001	2,987 (21.1)	2,871 (43.3)	<0.0001	0 (0.0)	5,858 (91.7)	<0.0001	0 (0.0)	5,858 (78.4)	<0.0001
Cardiovascular risk factors	527 (3.5)	5,858 (100.0)	<0.0001	2,804 (29.2)	3,581 (32.1)	<0.0001	3,303 (23.4)	3,082 (46.4)	<0.0001	0 (0.0)	6,385 (100.0)	<0.0001	0 (0.0)	6,385 (85.5)	<0.0001
Concomitant diseases	1,612 (10.8)	5,858 (100.0)	<0.0001	3,188 (33.2)	4,282 (38.3)	<0.0001	4,149 (29.4)	3,321 (50.0)	<0.0001	1,085 (7.5)	6,385 (100.0)	<0.0001	0 (0.0)	7,470 (100.0)	<0.0001
Concomitant treatments	1,544 (10.4)	5,858 (100.0)	<0.0001	3,156 (32.9)	4,246 (38.0)	<0.0001	4,099 (29.0)	3,303 (49.8)	<0.0001	1,085 (7.5)	6,317 (98.9)	<0.0001	0 (0.0)	7,402 (99.1)	<0.0001
Pharmacy SBP (mm Hg)	137.7 ± 18.0	136.9 ± 18.7	0.002	139.8 ± 17.5	135.5 ± 18.5	<0.0001	136.8 ± 17.1	138.9 ± 20.2	<0.0001	137.9 ± 17.9	136.7 ± 18.7	<0.0001	138.1 ± 18.0	136.5 ± 18.4	<0.0001
Pharmacy DBP (mm Hg)	87.8 ± 12.5	83.8 ± 13.0	<0.0001	88.7 ± 12.3	84.9 ± 12.9	<0.0001	89.5 ± 11.6	80.6 ± 12.9	<0.0001	87.9 ± 12.4	83.8 ± 13.0	<0.0001	87.9 ± 12.5	84.3 ± 12.9	<0.0001
24-hour SBP (mm Hg)	125.2 ± 12.3	124.5 ± 12.5	<0.0001	127.7 ± 12.0	122.7 ± 12.2	<0.0001	124.2 ± 12.0	126.9 ± 13.1	<0.0001	125.3 ± 12.3	124.4 ± 12.6	<0.0001	125.5 ± 12.3	124.2 ± 12.4	<0.0001
24-hour DBP (mm Hg)	77.1 ± 8.8	73.2 ± 8.8	<0.0001	78.7 ± 8.8	73.7 ± 8.6	<0.0001	78.5 ± 8.4	70.7 ± 7.8	<0.0001	77.3 ± 8.8	73.2 ± 8.8	<0.0001	77.3 ± 8.8	73.7 ± 8.8	<0.0001
Daytime SBP (mm Hg)	129.2 ± 12.7	127.9 ± 12.7	<0.0001	131.6 ± 12.4	126.4 ± 12.5	<0.0001	128.4 ± 12.3	129.7 ± 13.4	<0.0001	129.3 ± 12.6	127.8 ± 12.8	<0.0001	129.4 ± 12.7	127.7 ± 12.7	<0.0001
Daytime DBP (mm Hg)	80.6 ± 9.4	76.2 ± 9.4	<0.0001	82.0 ± 9.4	77.0 ± 9.1	<0.0001	82.2 ± 8.8	73.2 ± 8.2	<0.0001	80.7 ± 9.3	76.2 ± 9.4	<0.0001	80.8 ± 9.4	76.8 ± 9.4	<0.0001
Nighttime SBP (mm Hg)	114.9 ± 13.5	115.8 ± 14.6	<0.0001	117.2 ± 13.5	113.3 ± 13.9	<0.0001	112.9 ± 12.6	119.8 ± 15.2	<0.0001	114.9 ± 13.5	115.6 ± 14.6	0.001	115.1 ± 13.5	115.1 ± 14.5	0.815
Nighttime DBP (mm Hg)	68.1 ± 8.8	65.7 ± 8.8	<0.0001	69.8 ± 8.7	65.3 ± 8.4	<0.0001	68.8 ± 8.7	64.5 ± 8.4	<0.0001	68.2 ± 8.8	65.7 ± 8.8	<0.0001	68.3 ± 8.8	65.9 ± 8.8	<0.0001

Data are shown as mean ± standard deviation or as absolute and relative frequency (in brackets). P values refer to the statistical significance of the between groups comparison. CV, cardiovascular; DBP, diastolic blood pressure; SBP, systolic blood pressure.

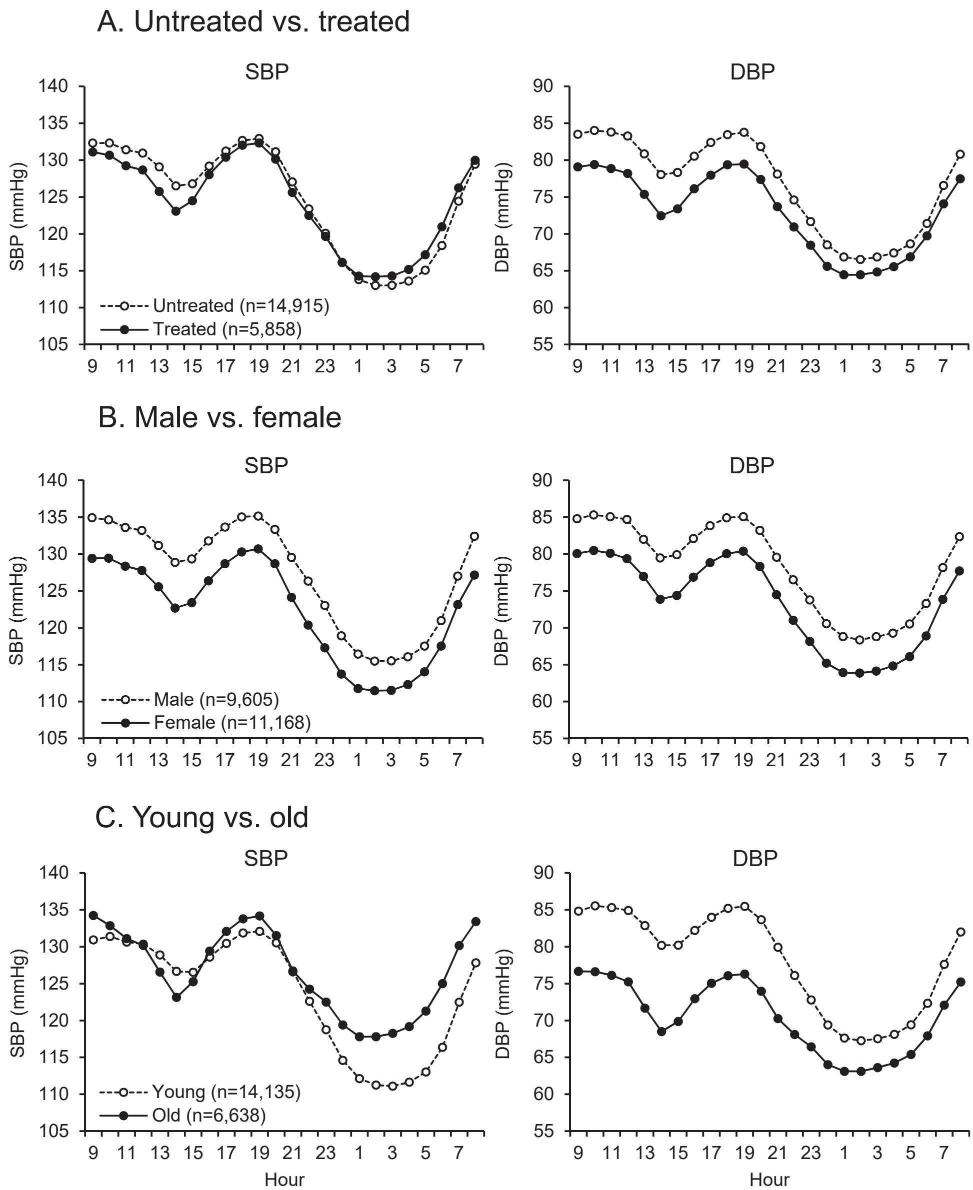

Figure 1. Hourly average systolic and diastolic blood pressure values in the different study subgroups. CV, cardiovascular; DBP, diastolic blood pressure; SBP: systolic blood pressure.

A sustained hypertension was more likely to be diagnosed in younger healthy men. Daytime hypertension was more important than nighttime hypertension in the determination of a concomitantly elevated "office-like" and 24-hour ambulatory BP. The only significant contributor to the definition of white-coat hypertension in our population was the female sex, whereas factors significantly associated with a diagnosis of masked hypertension were the male sex, an older age, an elevated BP at night, and to a less extent a high BP during the day.

DISCUSSION

In this study performed in a large nationwide cohort of subjects having an ABPM done through Italian community pharmacies, we observed a higher rate of BP elevation when BP was estimated in the pharmacy (57%) than over the 24 hours (46%). The prevalence of "office-like" uncontrolled hypertension in the pharmacy is in line with that documented in other Italian community studies.[9–11] However, the evaluation of ambulatory uncontrolled hypertension provided by ABPM in our study offers a less discouraging picture than that obtained by considering "office-like" data obtained in the pharmacy. This discrepancy between office and ambulatory BP control confirms the results of previous national and international registries[12–15] and reaffirms the importance of ABPM in the context of hypertension management, extending its utility to a pharmacy setting.

Our study, so far the largest telehealth-based registry of ABPMs performed in community pharmacies, also provides

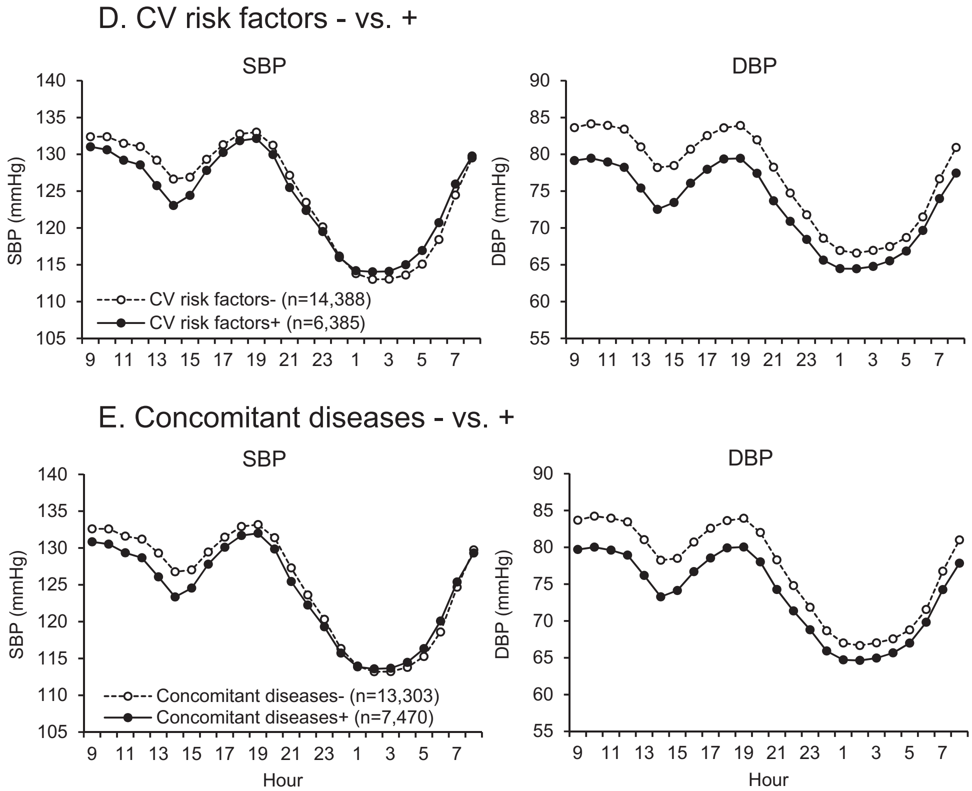

Figure 1. Continued

several interesting insights into the features and prevalence of BP elevation. We found that 24-hour or isolated daytime hypertension was more common among younger men at low CV risk, whereas isolated nocturnal hypertension was much more prevalent than isolated daytime hypertension and more often reported in older individuals, particularly when treated with antihypertensive medications or at higher CV risk. These findings confirm that some subjects may be misclassified depending on the period of the day (awake or asleep) considered for the categorization. The fact that isolated nocturnal hypertension was more likely to occur in older treated individuals and the evidence from the literature that this condition is strongly related to CV disease morbidity and mortality suggest that doctors should use ABPM more often in the management of their patients with hypertension.[5]

We highlights for the first time that white-coat and white-coat uncontrolled hypertension (high "office-like" BP with normal ambulatory BP) may be found with relatively high frequency also when using BP measurements obtained in a pharmacy setting, i.e., outside the doctor's office, thus indicating that an emotional reaction may characterize also BP measurements obtained in this environment. In our study, the prevalence of white-coat hypertension was somewhat smaller than in other settings.[14,16–19] However, its calculation included daytime, nighttime, and 24-hour average BPs, which seems to be the most appropriate approach, as documented by recent studies and as recommended by guidelines.[5,17,20,21] As for previous large registries, the major and most significant determinant of white-coat hypertension in our population was the female sex, but also the presence of CV risk factors or concomitant diseases, or use of antihypertensive medications (in white-coat uncontrolled individuals) played a pivotal role.[12,14,22–24]

The prevalence of masked and masked uncontrolled hypertension (normal "office-like" BP and elevated ambulatory BP) in our study did not substantially differ from that reported in the literature.[25–28] As observed in previous large studies, masked hypertension in our registry was more likely to be observed in treated older males, particularly when an isolated nocturnal hypertension was diagnosed.[26,29–34] Because masked hypertension is associated with a markedly increased risk for CV morbidity and mortality, our results suggest that the presence of such condition should be carefully sought in older treated hypertensive patients at increased CV risk.[30,35,36]

Study limitations

Although based on a very large sample of individuals evaluated in a community, setting with an objective BP measuring technique our study has some limitations. First, we cannot exclude a "selection bias" and an "indication bias" in patients' selection, favoring participation of subjects with a tendency toward BP elevation, which might contribute to explain the high rates of subjects with an elevated "office-like" BP or with white-coat hypertension in our sample.

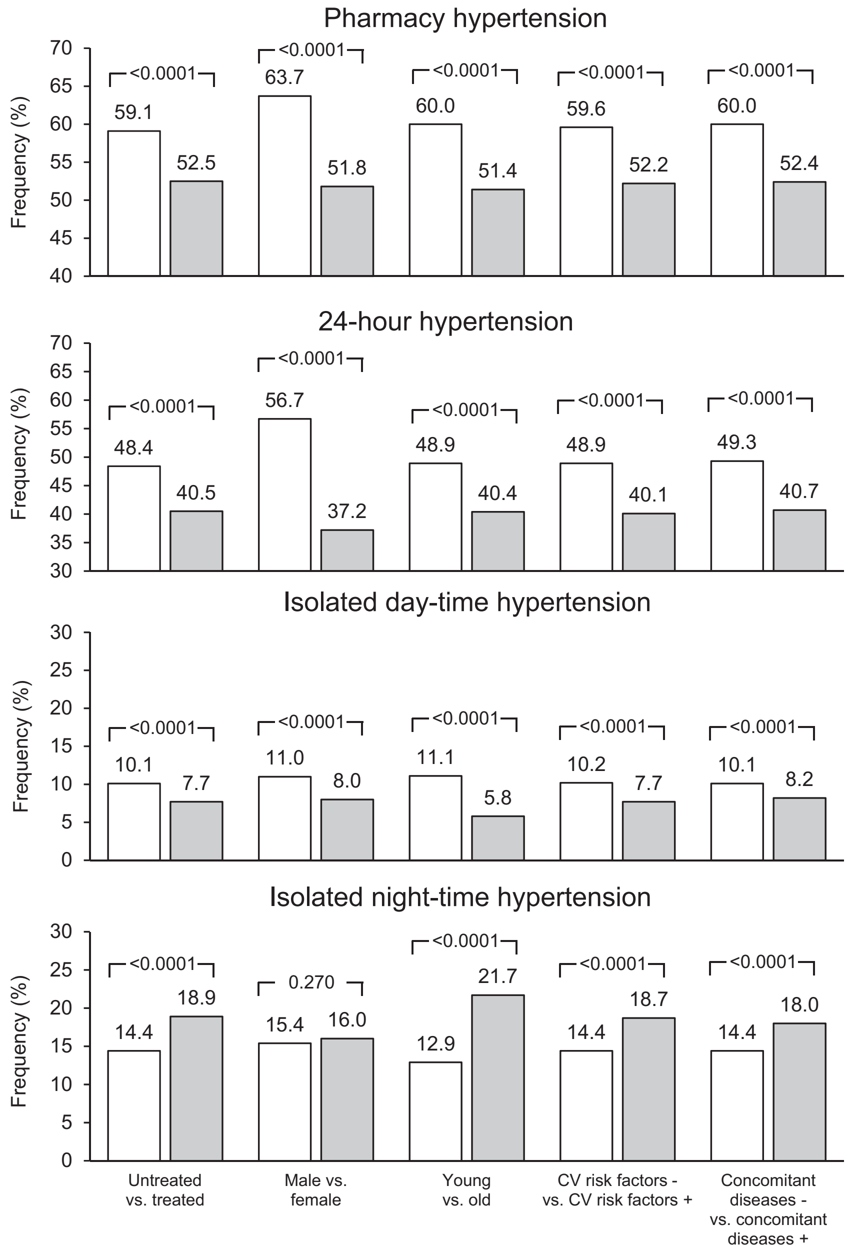

Figure 2. Bar charts of the frequency (as a percentage, %) of subjects with pharmacy hypertension, 24-hour hypertension, isolated daytime hypertension and isolated nighttime hypertension (for the definitions see methods). CV, cardiovascular.

However, hypertension prevalence, treatment, and control in our population and distribution within the country did not substantially differ from the estimates provided by large national registries.[37,38]

Second, our office BP determination was based on a single reading taken in the pharmacy immediately before starting the ABPM recording, in 1 single visit. How much BP measured in a pharmacy might compare with that measured in a doctors' office is yet not entirely clear.[39] However, the isolated BP measurements obtained in a single occasion in no standardized conditions might have led to an overestimation of true "office-like" BP, even in the absence of a physician, and thus determined a gap between pharmacy BP and ambulatory BP larger than that probably achieved with the repeated measurements obtained over multiple visits in a doctor's office. Data obtained in such a situation seem to closely reproduce what often happens in routine clinical practice, where BP is often determined during a single visit and with only 1 measurement.

Third, we could have missed some relevant clinical information pertinent to the subject performing the ABPM, as patients might not provide all the required data when interviewed by a pharmacist rather than by their own physician. Nevertheless, all these limitations may characterize real-world clinical practice where the approach to ABPM might better compare to what done in our pragmatic study

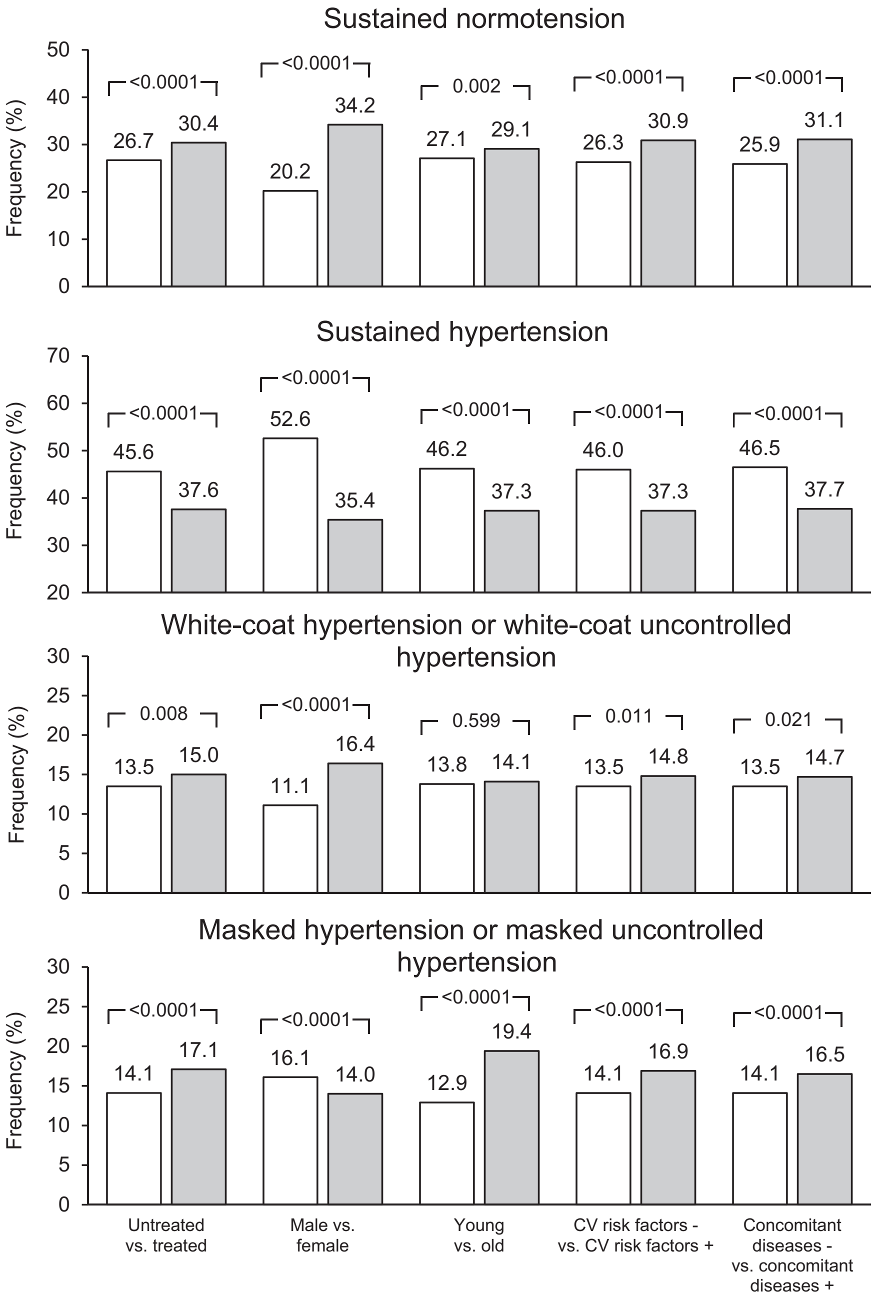

Figure 3. Bar charts showing the distribution of subjects with sustained normotension, sustained hypertension, white-coat hypertension, and masked hypertension in the different study subgroups (for the definitions see methods). BP, blood pressure; CV, cardiovascular; DBP: diastolic blood pressure; SBP: systolic blood pressure.

than to what is scheduled in clinical trials, thus more closely reflecting how patients are managed in daily general practice.

Fourth, in the current presentation, we concentrated our efforts on the provision of data regarding BP control in the pharmacy setting and we did not provide information on the utility, validity, and acceptability of the process. However, a specific ongoing analysis is addressing these aspects and its results will be reported in a forthcoming publication.

Finally, our study had a cross-sectional design, which did not allow to explore the prognostic value of ABPM data obtained according to our approach. In spite of these limitations, the large number of patients included, all of whom performing 24-hour ABPM, and the use of telehealth make our data valuable in evaluating the BP levels and the different BP phenotypes that might characterize a general practice condition.

The results of our large ABPM Registry support the recommendation for a wider use of ABPM also in nonconventional settings, as the community pharmacies, provided that such test is offered under medical supervision, after proper training and certification of the pharmacists and through adoption of modern information and communication technologies, which allow the creation of an efficient

Table 2. Predictors of different types of hypertension derived from logistic regression analysis

	24-hour hypertension		Isolated daytime hypertension		Isolated nighttime hypertension	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Sex (male vs. female)	2.155 (2.037, 2.280)	<0.0001	1.337 (1.216, 1.469)	<0.0001	1.027 (0.952, 1.108)	0.491
Age (old vs. young)	0.821 (0.772, 0.874)	<0.0001	0.527 (0.468, 0.593)	<0.0001	1.800 (1.663, 1.948)	<0.0001
CV risk factors (yes vs. no)	0.842 (0.737, 0.962)	0.012	0.762 (0.615, 0.943)	0.013	1.229 (1.020, 1.481)	0.030
Concomitant diseases (yes vs. no)	0.875 (0.771, 0.994)	0.040	1.126 (0.922, 1.375)	0.245	0.965 (0.806, 1.156)	0.699
	Sustained hypertension		**White-coat hypertension (white-coat uncontrolled hypertension in treated patients)**		**Masked hypertension (masked uncontrolled hypertension in treated patients)**	
	OR (95% CI)	***P* value**	**OR (95% CI)**	***P* value**	**OR (95% CI)**	***P* value**
Sex (male vs. female)	1.956 (1.855, 2.084)	<0.0001	0.646 (0.594, 0.703)	<0.0001	1.255 (1.149, 1.370)	<0.0001
Age (old vs. young)	0.823 (0.772, 0.878)	<0.0001	1.000 (0.914, 1.094)	0.999	1.394 (1.269, 1.531)	<0.0001
CV risk factors (yes vs. no)	0.904 (0.786, 1.039)	0.154	1.187 (0.798, 1.442)	0.083	0.997 (0.809, 1.228)	0.975
Concomitant diseases (yes vs. no)	0.808 (0.708, 0.923)	0.002	0.956 (0.794, 1.152)	0.636	1.053 (0.861, 1.287)	0.616
Isolated daytime hypertension (yes vs. no)	6.022 (5.363, 6.761)	<0.0001	—	—	4.015 (3.532, 4.565)	<0.0001
Isolated nighttime hypertension (yes vs. no)	1.519 (1.405, 1.642)	<0.0001	—	—	16.472 (14.978, 18.115)	<0.0001

Cardiovascular risk factors include treated arterial hypertension, known cardiovascular disease, diabetes or dyslipidemia, whereas concomitant diseases include all known diseases and treatments. For explanation about the definition of the different hypertension types please refer to the methods section. CI, confidence interval; CV: cardiovascular. OR, odds ratio;.

patient-centered healthcare network.[4,39,40] Further economic and prospective analyses of the data of our Registry will be needed to explore the potential public health benefits of the proposed approach more in depth.

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The TEMPLAR (TEleMonitoring of blood Pressure in Local phARmacies) Project Group

Promoter and Scientific Coordinator:

Stefano Omboni (Varese)

Scientific Committee of the Working Group on Blood Pressure Monitoring of the Italian Society of Hypertension (SIIA):

Gianfranco Parati (Milano), Paolo Palatini (Padova), Elisabetta Benetti (Padova), Renzo Carretta (Trieste), Francesco Cocco (Manduria, Taranto), Ferdinando D'Amico (Messina), Antonio Del Giudice (San Giovanni Rotondo, Foggia), Alessandra de Tschudy (Roma), Antonio Ferrara (Castrovillari, Cosenza), Guido Garavelli (Cremona), Claudio Guadagni (Ravenna), Guglielmo Mazzocca (Abano Terme, Padova), Stefano Omboni (Varese), Claudio Pini (Como), Maria Pia Rodighiero (S. Bortolo, Vicenza), Francesca Saladini (Padova), Alvaro Vaccarella (Lecco), Antonella Velardi (Roma), Maddalena Veronesi (Bologna)

Scientific Committee of the Italian Society of General Practitioners (SIMG):

Antonino Di Guardo (Catania), Gaetano Profeta (Catania), Alessandro Filippi† (Bergamo).

DISCLOSURE

SO is scientific consultant of Biotechmed Ltd, provider of telemedicine services. The other authors declare no conflicts of interest regarding the publication of this article.

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