# Ethnicity and differences between clinic and ambulatory blood pressure measurements.

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# ABSTRACT

**Background:** This study investigated the relationship of ethnicity to the differences between blood pressure (BP) measured in a clinic setting and by ambulatory monitoring (ABPM) in individuals with and (HT) without (NHT) a previous diagnosis of hypertension.

**Methods:** A cross sectional comparison of BP measurement was performed in 700 participants (White British (39%), South Asian (31%) and African Caribbean (30%)) in 28 primary care clinics in West Midlands UK. Mean differences between daytime ABPM, standardised clinic (mean of three occasions), casual clinic (first reading on first occasion) and last routine BP taken at the GP practice were compared in HT and NHT individuals.

**Results**: Daytime systolic and diastolic ABPM readings were similar to standardised clinic BP (systolic: 128(SE0.9)vs125(SE0.9)mmHg (NHT) and 132(SE0.7)vs131(SE0.7)mmHg (HT)) and were not associated with ethnicity to a clinically important extent. When BP was taken less carefully differences emerged: casual clinic readings were higher than ABPM, particularly in the HT group where the systolic differences approached clinical relevance (131(SE1.2)vs129(SE1.0)mmHg (NHT) and 139(SE0.9)vs133(SE0.7)mmHg (HT)) and were larger in South Asian and African Caribbean hypertensive individuals (136(SE1.5)vs133(SE1.2)mmHg (WB) and 141(SE1.7)vs133(SE1.4)mmHg (SA) and 142(SE1.6)vs134(SE1.3)mmHg (AC)) mean differences 3(0-7),p=0.03 and 4(1-7),p=0.01, respectively. Differences were also observed for the last practice reading in South Asian and African Caribbeans.

**Conclusions**: Blood pressure differences between ethnic groups where BP is carefully measured on multiple occasions are small and unlikely to alter clinical management. When BP is measured casually on a single occasion or in routine care, differences appear that could approach clinical relevance.

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# INTRODUCTION

High blood pressure (BP) is an important risk factor for cardiovascular disease and is a major cause of mortality and morbidity world wide.[1,2] Accurate assessment of BP requires several measurements. UK guidelines recommend that potentially hypertensive patients using clinic blood pressure should have the diagnosis confirmed with 24 hour ambulatory blood pressure monitoring (ABPM).[3] ABPM also has a role in the clinical management of hypertension: it may help to improve treatment,[4] identify resistant hypertension, [4] diagnose white coat hypertension (where BP is raised in a clinic situation but not otherwise),[5-7] predict cardiovascular outcomes, [8,9] and identify reduced night time dipping.[10]

Few studies of BP measurement undertaken over the last 20 years have included people from diverse ethnic groups having both clinic and ambulatory measurements,[11] although differences in ethnicity are known to be associated with cardiovascular outcome.[12] In the UK, South Asian people have a 40-50% greater risk of mortality from coronary heart disease (CHD) compared to the general population with evidence that the poorest groups of Pakistanis and Bangladeshis have the worst mortality rates. [13-15] Mortality from CHD in migrant African Caribbean people is lower than the national average but stroke deaths are higher, with hypertension being the major risk factor.[16-19] Poor mental health and more depressive symptoms have also been associated with a diagnosis of hypertension in black subjects in the US.[20]

The diagnosis and management of BP in the UK are informed by guidelines largely based on research from white populations.[4] Current adjustment between clinic and "out-of-office" thresholds for diagnosis is based on Australian data gathered in a population that was 82% white and 15% Asian.[21]

The calculated adjustments are a decrease of 5/5mmHg when converting from mean day time ambulatory readings at lower levels (stage 1) and a decrease of 10/5mmHg at higher levels (stage 2).[4] At present, ethnicity is not considered when interpreting out of clinic or ambulatory readings.

Hypertension remains a significant and treatable risk factor in all ethnic groups and accurate BP readings are crucial. Nonetheless, among present guidelines there are different recommendations for the optimal number of clinic readings needed and the place of ABPM in diagnosis and ongoing care.[3,4,5,6,22] There are few data regarding whether the "white coat" and/or "masked" (BP normal in a clinic situation but raised otherwise) effects seen between ambulatory and clinic readings for white British populations are similar in minority ethnic communities.[23,24,25]

The BP-Eth study compared ABPM and clinic readings in people of different ethnic groups in a primary care setting with either no previous diagnosis of hypertension, or known hypertension, in order to determine the extent to which ethnicity is associated with differences in BP readings.

# METHODS

BP-Eth was a primary care based observational study which took place between June 2010 and December 2012, the methods of which have been described previously and are outlined below and in Figure 1.[26]

## Population

The study population was recruited from primary care and included people between the ages of 40 to 74 years, the age group where most primary prevention decisions are made.[27] Participants were purposefully recruited from three ethnic groups (white British, South Asian, and African Caribbean )

to include both those with and without a previous diagnosis of hypertension. We planned to recruit a fourth ethnic group, white Irish, but only 51 people of this ethnicity were recruited, so they have been excluded from this analysis. Ethnicity was self defined using standard UK criteria http://www.ons.gov.uk/ons/guide-method/measuring-equality/equality/ethnic-nat-identity-religion/ethnic-group/index.html#skiptotop.[28] Individuals that were unable to give consent, belonged to a different ethnic group or whose general practitioner felt inappropriate to take part were excluded. Participants needed to have had at least one BP recorded in their electronic medical records within the last year.

## Setting

Twenty eight practices were recruited from the Primary Care Research Network-Central England (PCRN-CE), UK,[29] chosen to represent the required range of ethnicities.

## Procedures

Consecutive consenting patients who were willing to have BP taken were recruited from primary care with the aim of including around 40 people from each practice. Respondents, with and without hypertension defined by a clinical code in the patient records, were invited to attend three clinics run at their own practices by research nurses and facilitators using standardised protocols. Following at least five minutes rest, six BP measurements were taken at each of the clinic visits (BpTru Medical Devices BPM-100)[30] and participants were fitted with an ambulatory monitor (or given a home monitor) on either the first or second visit in random order (Spacelabs 90217-1Q).[31] Ambulatory readings were recorded at half hourly intervals during the day and hourly overnight for a total of 24 hours. The final visit took place 10 days after the first. On the first occasion, the BP was measured simultaneously in both arms and thereafter it was measured on the non-dominant arm unless the difference in systolic pressure was >20mmHg between both arms, in which case it was

measured in the arm with the higher reading.[3]  The last reading recorded on the practice computer was also noted.

## Outcome Measures

The primary outcome was the mean difference between the reference standard (mean daytime ambulatory BP, at least 14 readings) and the standard research reading (mean of 2nd and 3rd reading on three different days, (standardised clinic). The ethnic groups were compared separately for people with a previous diagnosis of hypertension and those without. Additional comparisons were made between mean daytime ABPM and the first clinic reading on the first day (casual clinic, designed to best capture the white coat effect), [32] and the last BP recorded in the clinical records at the GP practice in order to gauge the impact of routine readings of blood pressure.

## Sample Size Considerations

Based on previous work in a white population, 200 patients per ethnic group would be sufficient to detect a systolic difference of 5mmHg in mean differences between any two populations (this is sufficient across the plausible range of standard deviations between 12-18 mmHg, power 80%).[33,34]

## Analysis

Mean Ambulatory day time blood pressure was compared with the two research clinic measures (standardised and casual) and routine practice measurement in each ethnicity for individuals treated for hypertension and those not known to previously have a diagnosis of hypertension. The last practice reading was restricted to those within a year of the research measurements. Each comparison was of interest and was assessed individually, so no adjustments for multiple comparisons were undertaken. Standard editing criteria were applied to ambulatory readings. Statistical significance was predefined at less than 5% whilst clinical relevance was defined as a difference of 5mmHg.

The continuous response variable was systolic or diastolic BP. The study design involved clustering effects (patients nested within general practice and BP readings nested within patients), so we used a hierarchical linear statistical model to reflect the study design and investigate the hypothesis of interest. A four level hierarchical model was developed, with level 1 as the BP readings, level 2 as the day (the readings were taken), level 3 as the patient and level 4 as the general practice. All models had a pre-specified set of covariates: ethnicity, age, sex, marital status, deprivation (IMD 2007), BMI, smoking status, alcohol consumption, cholesterol, cardiovascular disease, diabetic status and practice. Three separate models were constructed for each comparison – ABPM vs standardised clinic; ABPM vs casual clinic, ABPM vs practice. Although participants did not provide equally balanced set of BP readings in all arms of the study, the separate models draw on relevant subsets from the same pool of data. All analyses were undertaken in Stata (release 12) and R.[35,36]

## Ethics and Research Governance Approvals

Ethical approval was gained from the Black Country Research Ethics Committee, West Midlands, UK: Ref 09/H1202/114.

# RESULTS

## Baseline data: demographics and past medical history

A total of 770 patients participated in the study (300 white British, 229 African Caribbean 241 South Asian) [table 1]. More hypertensives than non hypertensives were recruited in each group; more men than women were recruited in white British and South Asian groups only. The White British group was older than the other two and more likely to drink alcohol. The South Asian group had lower prevlance of smoking but were more likely to be diabetic.

Standardised clinic readings were available for 767 (99.6%) participants and casual clinic readings (first reading on the first day) for 756 (98.2%). Valid (>= 14 daytime readings) ABPM readings were available for 636 (82.6%) patients.  A last practice BP reading was available for all but one patient (99.9%).

# Blood pressure measurements

Standardised clinic systolic blood pressure was similar to, but slightly lower, than ambulatory day time monitoring (Figures 2 and 3, ambulatory vs standard systolic BP, 128(SE0.9) vs 125(SE 0.9)mmHg (NHT) and 132(SE0.7) vs 131(SE0.7)mmHg (HT) respectively). In addition, no clinically relevant differences were observed between ethnic groups in ambulatory or standardised clinic blood pressure measurement for both systolic and diastolic BP, in either hypertensive or non hypertensive individuals (Figure 2 and 3, Table 2).

When blood pressure was measured once in the clinic (casual clinic measurement i.e. first reading on the first day), both systolic and diastolic BP readings were higher than mean day time ABPM and this difference was significantly greater in the group with a previous diagnosis of hypertension compared to those without (ambulatory vs casual systolic BP, 129(SE1.0) vs 131(SE1.2)mmHg (NHT) and 133(SE0.7) vs 139(SE0.9)mmHg (HT), mean difference 4 (95%CI 2 to 6), p<0.01 and diastolic BP 78(SE0.6) vs 81(SE0.8)mmHg (NHT) and 81(SE0.4) vs 86(SE0.6)mmHg (HT) mean difference 2 (95%CI 0 to 3), p=0.02, Table 2. Ethnic differences emerged in the hypertensive group only: South Asian and African Caribbean people had significantly greater differences in casual clinic and ABPM systolic readings compared to white British people with the clinic readings higher and approaching a clinically relevant level (ambulatory vs casual: 133(SE1.2) vs 136(SE1.5)mmHg (WB) and 133(SE1.4) vs 141(SE1.7)mmHg (SA) and 134(SE1.3) vs 142(SE1.6)mmHg (AC) mean differences 3(0 to 7), p=0.03 and 4(1 to 7), p=0.01, respectively).

Systolic ambulatory readings in white British individuals both with and without a previous diagnosis of hypertension were lower than last systolic readings recorded at the GP practice (Figure 2). The opposite pattern was observed in South Asian and Afro Caribbeans without a previous diagnosis of hypertension, reaching significance compared with the white British in the South Asian (128(SE1.3) vs 129(SE1.8)mmHg (WB) compared with 126(SE1.6) vs 123(SE2.0)mmHg (SA) -5(95%CI -8 to -1)

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p=0.02) but not the African Caribbean  group  (132(SE 1.7) vs 129(SE 2.2)mmHg (AC) -4(95%CI -8 to 0) p=0.06, compared with WB).

# DISCUSSION

This study has shown that when BP is carefully measured in a research clinic on three separate occasions, the difference between the mean of such readings and the ambulatory reference standard is small and similar regardless of ethnicity. However, where clinic blood pressure is measured less carefully – either on a single (casual) reading or under "usual care" at the GP practice, significant differences between ethnic groups appear which, whilst relatively small, approach the level where management decisions could be affected, particularly for readings around recommended diagnosis or treatment thresholds.

Participants were recruited from primary care practices in the West Midlands with an appropriately mixed ethnic balance. We had ample power to detect the a priori defined clinically important differences between measurement modalities by ethnicity; several of the smaller differences that we observed were of statistical significance-even at 1%-but did not achieve clinical relevance and indeed varied in direction suggesting there may be an element of random variation.

The modelling was designed to take into account a large number of potentially important differences between groups allowing direct comparison. Inevitably, however, unmeasured confounding differences between the ethnic groups may have contributed to the observed results. As with most studies of this type, we depended on volunteers, hence our results may not represent those of the population at large but are likely to be more representative than populations recruited from specialist hypertension clinics.  Readings taken at the GP practice were very variable and we have no

knowledge of the methodology used-this probably included a combination of single and multiple readings made by GPs and nurses.[37]

Surprisingly few studies have made direct comparisons between BP measured in the clinic or GP surgery and by ABPM, particularly by ethnic group and including both hypertensive and non-hypertensive individuals.[21,38,39] Compared to these, the clinic blood pressures measured across all ethnicities in the current study were in general lower relative to ABPM than might have been expected. Staessen et al., analysed ambulatory blood pressure in 7069 normotensive and hypertensive subjects from an international database and demonstrated similar ambulatory and clinic readings in normotensive individuals but lower ambulatory readings than clinic readings (at least two measurements) both in borderline and definite hypertensives.[38] The Italian PAMELA study included 1500 subjects stratified by sex and ten year age groups and compared clinic readings (mean of three measurements, taken on two occasions) with day time average blood pressure and again found that clinic readings were higher than ambulatory.[39] They did not exclude the first clinic readings on both days, however, which would have given a higher mean pressure than in the present study. Additionally, when they excluded individuals with clinic BP≥140/90 mmHg, mean systolic daytime ambulatory and clinic readings were similar, as seen in the current study.

Other studies have reported higher clinic than ambulatory readings in hypertensive individuals: Stergiou's group performed multiple measurements in 133 unmedicated hypertensive Greek individuals with raised clinic BP (90-115mmHg diastolic) and found clinic BP to be consistently higher than ambulatory or home measurements.[40] Participants attended five clinic visits at 3 week intervals over 3 months as opposed to 10 days in the present study. Triplicate measurements were taken by doctors (as opposed to nurses/research facilitators in the present study) and the mean of the second and third reading was taken for analysis; the measurements from the fifth visit were used unless patients were treated earlier in which case the measurements from the third visit were used. In

addition ambulatory monitoring was done on two occasions and the mean day time readings were used from both days. Despite the progressive decline in clinic BP over the course of the study, the final clinic BP was still higher than the ambulatory BP.

Head analysed ambulatory and clinic data from 11 hypertension clinics, where measurements were mainly taken by nursing and research staff (not doctors).[21] The average number of clinic readings was 2.4/per person if the initial measurement was excluded. The daytime ambulatory systolic/diastolic ambulatory equivalent to the lower limit of stage 1 hypertension was estimated to be 4/3 mmHg lower than seated clinic values; the estimate for stage 2 hypertension was 8/4 mmHg lower and for grade 3 hypertension was 12/6 mmHg lower. In a sub analysis of readings taken by doctors, ambulatory readings were even lower e.g. for stage 1 hypertension an 11/9 mmHg difference.

These results are in direct contrast to our study where higher clinic than ambulatory readings were only demonstrated when a single casual clinic reading was used. When BP was measured carefully in the clinic on several occasions, it was similar to ambulatory readings, whether or not there was a previous diagnosis of hypertension. Careful measurement of BP on a number of occasions may therefore give a "true" reading not dissimilar to ambulatory measurements, particularly if measurement is not predicated on a high clinic reading when regression to the mean will lead to an apparent drop in BP.[41] In addition, standard clinic readings were included before and after ABPM (and home readings) so a degree of habituation may have occurred.[42] The results suggest the possibility that such assessment of BP in the clinic may be an alternative to ambulatory monitoring and may be preferable under certain circumstances, particularly when the patient is reluctant to undertake ABPM. On the other hand, casual or less careful measurement of BP in the clinic or at the general practice may potentially lead to inaccuracies which could in turn affect clinic management.

An important difference between the present study and many others is that patient groups were selected on the basis of ethnicity and whether they had a label of hypertension or not recorded at the general practice, rather than by blood pressure level itself (which was within the normal range in both groups). This may explain why our results are different from other studies where ABPM was lower than clinic readings in hypertensive patients.[38,39,40] but not in normotensive individuals.[38,39] In addition, one reason for the similarity in clinic and ambulatory readings may be that standardised clinic BP was measured within an approximately 10 day period which may have resulted in participants becoming used to BP measurement, therefore further reducing any "white coat" effects. The use of ABPM (and home monitoring) between clinic measurements could have also had this effect as discussed above. A further important difference is that individuals were recruited from primary care and so may have different characteristics than patients referred to a specialist hypertension clinic. Finally, despite the fact that all clinics were undertaken in patients' own GP practices, measurements made by the study team were all done under far more controlled circumstances and with more consistent methodology than is likely in routine clinical setting where time constraints and competing priorities may undermine the optimum BP measurement process.

In terms of differences due to ethnicity, Agyemang et al., reviewed the evidence for white coat effects by ethnic group including both intra arterial and non invasive methodologies.[23] They found that the mean difference between clinic and ambulatory BP was similar between white and black ethnic groups but that in the two studies including South Asians, a smaller white coat effect was seen. Most data were available for blacks and whites and the UK non invasive studies included less than 50 patients per group. No non invasive data were available for South Asian populations. In 1993, Chaturvedi assessed clinic and ABPM in whites compared to African Caribbeans, with ethnic group assigned by the investigator "based on appearance and parental origin".[24] The key difference was a reduction in nocturnal dip in the "African Caribbean" group compared to the "European Group".[24] Nocturnal pressure in treated hypertension has also been reported as greater in African

Caribbeans.[25] The present study suggests that little ethnic difference exists in the comparison of clinic and day time ABPM readings, provided the BP is taken properly, with repeat measurements on at least three occassions.

## CONCLUSIONS

Blood pressure differences between ambulatory and clinic measurements where BP is carefully measured on multiple occasions are small, do not vary by ethnic group and are unlikely to alter clinical practice. When BP is measured casually on a single occasion or in routine practice, differences between clinic and ambulatory measurements appear as do apparent differences between ethnic groups that could approach clinical relevance and affect clinical management. This work emphasises the importance of careful blood pressure measurement irrespective of ethnic group and suggests that where this is not undertaken, erroneous difference may occur which could have an impact on clinical decisions.

# Disclosures

The authors declare that they have no conflict of interest to declare.

# Acknowledgements

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## Contributorship

RJM and UM had the original idea for this work and gained funding in collaboration with PG, JM, SG, JC and MM.  GH, AJ, CS and SW collected the data in collaboration with colleagues in the PCRN-CE. SH and MM did the analyses.  RJM, UM, PG and SW wrote the first draft of this paper and all authors subsequently assisted in redrafting and have approved the final version.  RJM will act as guarantor.

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# LEGENDS FOR FIGURES

**Figure 1:** The BP-Eth study: recruitment and methods.

**Figure 2:** Mean difference between the systolic mean daytime ambulatory BP and the standard systolic research reading (mean of 2nd and 3rd reading on three different days, (standardised clinic), the first systolic clinic reading on the first day (casual clinic) and the last systolic practice BP recorded in the clinical records.

**Figure 3:** Mean difference between the diastolic mean daytime ambulatory BP and the standard diastolic research reading (mean of 2nd and 3rd reading on three different days, (standardised clinic), the first diastolic clinic reading on the first day (casual clinic) and the last diastolic practice BP recorded in the clinical records.

# LEGENDS FOR TABLES

**Table 1:** Characteristics of study population

Numbers are Mean (SD) for continuous variables and Number (Percentage) for categorical variables, Index of Multiple Deprivation 2007 score

WB: White British; SA: South Asian; AC: African Caribbean

**Table 2:** Differences between clinic and ambulatory blood pressure measurements in white British, South Asian and African Caribbean individuals with and without a previous diagnosis of hypertension.

Figures are model adjusted mean BP readings (with model based standard errors SE) and their differences with 95% CI in the parentheses, accounting for small variations.
Ambulatory: mean daytime ambulatory BP; Standardised: mean of second/third readings on three occasions; Casual: first reading on first day;
Practice: Last available practice reading

| | | Not known to be hypertensive | | | | Diagnosed hypertensive | | | | All |
|---|---|---|---|---|---|---|---|---|---|---|
| | | WB | SA | AC | All | WB | SA | AC | All | |
| | n | 116 | 97 | 76 | 289 | 184 | 144 | 153 | 481 | 770 |
| Age | | 59.1 (9.2) | 51.7 (8.3) | 51.5 (7.8) | 54.6 (9.3) | 63.6 (7.9) | 59.0 (8.9) | 59.8 (9.4) | 61.0 (8.9) | 58.6 (9.6) |
| Male | | 50 (43.1) | 51 (52.6) | 33 (43.5) | 134 (46.4) | 104 (56.5) | 81 (56.3) | 55 (36.0) | 240 (49.9) | 374 (48.6) |
| Married/Cohabiting | | 77 (66.4) | 80 (82.5) | 39 (51.3) | 196 (67.8) | 111 (60.3) | 128 (88. 9) | 49 (32.0) | 288 (59.9) | 484 (62.9) |
| Employed or F.T. Student or Housewife/husband | | 58 (50.0) | 75 (78.1) | 50 (68.5) | 183 (64.2) | 45 (25.0) | 71 (50.0) | 57 (38.3) | 173 (36.7) | 359 (47.0) |
| Deprivation* | | 34.9 (15.8) | 43.1 (17.2) | 51.8 (13.7) | 42.1 (17.2) | 37.8 (17.8) | 43.6 (16.8) | 48.7 (15.6) | 43.0 (17.4) | 42.7 (17.3) |
| Smoker | | 22 (19.0) | 8 (8.3) | 10 (13.2) | 40 (13.8) | 31 (16.9) | 6 (4.2) | 31 (20.3) | 68 (14.1) | 108 (14.0) |
| Alcohol | | | | | | | | | | |
| Non-drinker | | 42 (36.2) | 78 (80.4) | 44 (57.9) | 164 (56.8) | 78 (42.6) | 115 (79.9) | 95 (62.1) | 288 (60.0) | 452 (58.8) |
| Mild/Moderate drinker | | 48 (41.4) | 17 (17.5) | 25 (32.9) | 90 (31.1) | 76 (41.5) | 22 (15.3) | 52 (34.0) | 15 (31.3) | 240 (31.2) |
| Heavy drinker | | 26 (22.4) | 2 (2.1) | 7 (9.2) | 35 (12.1) | 29 (15.9) | 7 (4.9) | 6 (3.9) | 42 (8.8) | 77 (10.0) |
| BMI | | 28.5 (5.1) | 27.6 (4.3) | 29.5 (6.0) | 28.4 (5.1) | 31.1 (6.0) | 29.8 (8.5) | 31.0 (6.4) | 30.7 (7.0) | 29.8 (6.4) |
| Healthy (19-25) | | 28 (24.4) | 26 (26.8) | 13 (17.1) | 67 (23.3) | 21 (11.5) | 24 (16.8) | 28 (18.3) | 73 (15.2) | 140 (18.3) |
| Overweight | | 51 (44.4) | 49 (50.5) | 34 (44.7) | 134 (46.5) | 67 (36.6) | 66 (46.2) | 42 (27.5) | 175 (36.5) | 309 (40.3) |
| Very overweight | | 36 (31.3) | 22 (22.7) | 29 (38.2) | 87 (30.2) | 95 (51.9) | 53 (37.1) | 83 (54.3) | 231 (48.2) | 318 (41.5) |
| High Cholesterol | | 16 (13.8) | 27 (27.8) | 10 (13.2) | 53 (18.3) | 87 (47.5) | 72 (50.0) | 44 (28.8) | 203 (42.3) | 256 (33.3) |
| Cardiovascular Disease | | 10 (8.6) | 7 (7.2) | 4 (5.3) | 21 (7.3) | 54 (29.4) | 26 (18.1) | 27 (17.7) | 107 (22.3) | 128 (16.6) |
| Diabetic | | 3 (2.6) | 12 (12.4) | 2 (2.6) | 17 (5.9) | 28 (15.3) | 51 (35.4) | 34 (22.2) | 113 (23.5) | 130 (16.9) |
| Chronic Kidney Disease | | 5 (4.3) | 2 (2.1) | 6 (7.9) | 13 (4.5) | 17 (9.3) | 12 (8.3) | 18 (11.8) | 47 (9.8) | 60 (7.8) |

Numbers are Mean (SD) for continuous variables and Number (Percentage) for categorical variables,
*Index of Multiple Deprivation 2007 score
WB: White British; SA: South Asian; AC: African Caribbean

|  | | Not known to be hypertensive (NHT) | | | | | Diagnosed with Hypertension (HT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYSTOLIC | | WB | SA | AC | WB v SA | WB v AC | WB | SA | AC | WB v SA | WB v AC | NHT | HT | NHT v HT |
| | n | 116 | 97 | 76 | | | 184 | 144 | 153 | | | | | |
| Ambulatory mean | | 128 | 126 | 131 | | | 131 | 133 | 133 | | | 128 | 132 | |
| SE | | 1.4 | 1.6 | 1.7 | | | 1.1 | 1.3 | 1.3 | | | 0.9 | 0.7 | |
| Standardised mean | | 125 | 122 | 127 | | | 129 | 131 | 133 | | | 125 | 131 | |
| SE | | 1.4 | 1.5 | 1.7 | | | 1.1 | 1.3 | 1.2 | | | 0.9 | 0.7 | |
| Ambulatory v Standardised | | 3 | 4 | 4 | -2 (-4 to 0) P=0.09 | -1 (-3 to 1) P=0.33 | 2 | 1 | 0 | 0 (-2 to 2) P=0.79 | 2 (0 to 4) P=0.03 | 3 | 1 | 2 (1 to 3) P<0.01 |
| Ambulatory mean | | 128 | 127 | 132 | | | 133 | 133 | 134 | | | 129 | 133 | |
| SE | | 1.4 | 1.7 | 1.8 | | | 1.2 | 1.4 | 1.3 | | | 1.0 | 0.7 | |
| Casual mean | | 132 | 128 | 133 | | | 136 | 141 | 142 | | | 131 | 139 | |
| SE | | 1.9 | 2.0 | 2.3 | | | 1.5 | 1.7 | 1.6 | | | 1.2 | 0.9 | |
| Ambulatory v Casual | | -4 | -1 | -1 | -3 (-7 to 1) P=0.12 | -3 (-7 to 1) P=0.14 | -4 | -7 | -8 | 3 (0 to 7) P=0.03 | 4 (1 to 7) P=0.01 | -2 | -6 | 4 (2 to 6) P<0.01 |
| Ambulatory mean | | 128 | 126 | 132 | | | 133 | 133 | 135 | | | 129 | 133 | |
| SE | | 1.3 | 1.6 | 1.7 | | | 1.1 | 1.3 | 1.2 | | | 0.9 | 0.7 | |
| Practice mean | | 129 | 123 | 129 | | | 136 | 133 | 138 | | | 127 | 136 | |
| SE | | 1.8 | 2.0 | 2.2 | | | 1.5 | 1.6 | 1.6 | | | 1.1 | 0.9 | |
| Ambulatory v Practice | | -1 | 4 | 3 | -5 (-8 to -1) P=0.02 | -4 (-8 to 0) P=0.06 | -4 | 1 | -3 | -4 (-7 to -1) P=0.01 | -1 (-4 to 2) P=0.58 | 1 | -2 | 4 (2 to 6) P<0.01 |
| DIASTOLIC | | | | | | | | | | | | | | |
| Ambulatory mean | | 77 | 77 | 80 | | | 79 | 81 | 82 | | | 78 | 81 | |
| SE | | 0.8 | 1.0 | 1.0 | | | 0.7 | 0.8 | 0.7 | | | 0.5 | 0.4 | |
| Standardised mean | | 78 | 77 | 81 | | | 80 | 82 | 84 | | | 78 | 82 | |
| SE | | 0.8 | 0.9 | 1.0 | | | 0.7 | 0.8 | 0.8 | | | 0.5 | 0.4 | |
| Ambulatory v Standardised | | -1 | 0 | -1 | -1 (-2 to 0) P=0.14 | 0 (-1 to 1) P=0.95 | -1 | -1 | -1 | -1 (-2 to 1) P=0.30 | 0 (-1 to 1) P=0.63 | 0 | -1 | 1 (0 to 1) P=0.10 |
| Ambulatory mean | | 77 | 77 | 80 | | | 80 | 81 | 83 | | | 78 | 81 | |
| SE | | 0.9 | 1.0 | 1.1 | | | 0.7 | 0.8 | 0.8 | | | 0.6 | 0.4 | |
| Casual mean | | 82 | 79 | 84 | | | 85 | 86 | 89 | | | 81 | 86 | |
| SE | | 1.2 | 0.7 | 1.5 | | | 1.0 | 1.1 | 1.0 | | | 0.8 | 0.6 | |
| Ambulatory v Casual | | -5 | -2 | -3 | -2 (-5 to 0) P=0.10 | -1 (-4 to 2) P=0.47 | -5 | -5 | -6 | 0 (-2 to 2) P=0.87 | 1 (-1 to 3) P=0.23 | -4 | -5 | 2 (0 to 3) P=0.02 |
| Ambulatory mean | | 77 | 77 | 80 | | | 80 | 81 | 83 | | | 78 | 81 | |
| SE | | 0.8 | 1.0 | 1.0 | | | 0.7 | 0.8 | 0.8 | | | 0.5 | 0.4 | |
| Practice mean | | 78 | 74 | 78 | | | 82 | 79 | 82 | | | 77 | 81 | |
| SE | | 1.2 | 1.3 | 1.4 | | | 0.9 | 1.1 | 1.0 | | | 0.7 | 0.6 | |
| Ambulatory v Practice | | -1 | 3 | 2 | -4 (-7 to -2) P<0.01 | -4 (-6 to -1) P=0.02 | -2 | 2 | 1 | -4 (-6 to -2) P<0.01 | -3 (-5 to -1) P=0.01 | 1 | 0 | 1 (0 to 2) P=0.12 |

Figures are model adjusted mean BP readings (with model based standard errors SE) and their differences with 95% CI in the parentheses, accounting for small variations.
Ambulatory: mean daytime ambulatory BP; Standardised: mean of second/third readings on three occasions; Casual: first reading on first day;
Practice: Last available practice reading

Invite consecutive willing respondents of appropriate ethnic group to take part in validation study at their own practice
N=770 (300 white British, 241 South Asian 229 African Caribbean)

↓

Day 1: Attend initial meeting with research nurse:
- Consent
- Initial questionnaire
- Clinic BP Measurement (3 readings)
- Participant trained re. home monitoring and issued with equipment*

↓

Day 9: Second visit to research nurse:
- Return home monitoring equipment having completed 7 days of monitoring
- Clinic BP Measurement (3 readings)
- Participant counselled re. ambulatory monitoring and issued with equipment
*Note: Order of home and ambulatory monitoring varied randomly

↓

Day 10: Third visit to research nurse:
- Return ambulatory monitoring equipment having completed 24 hours of recording
- Clinic BP Measurement (3 readings)
- Final questionnaires

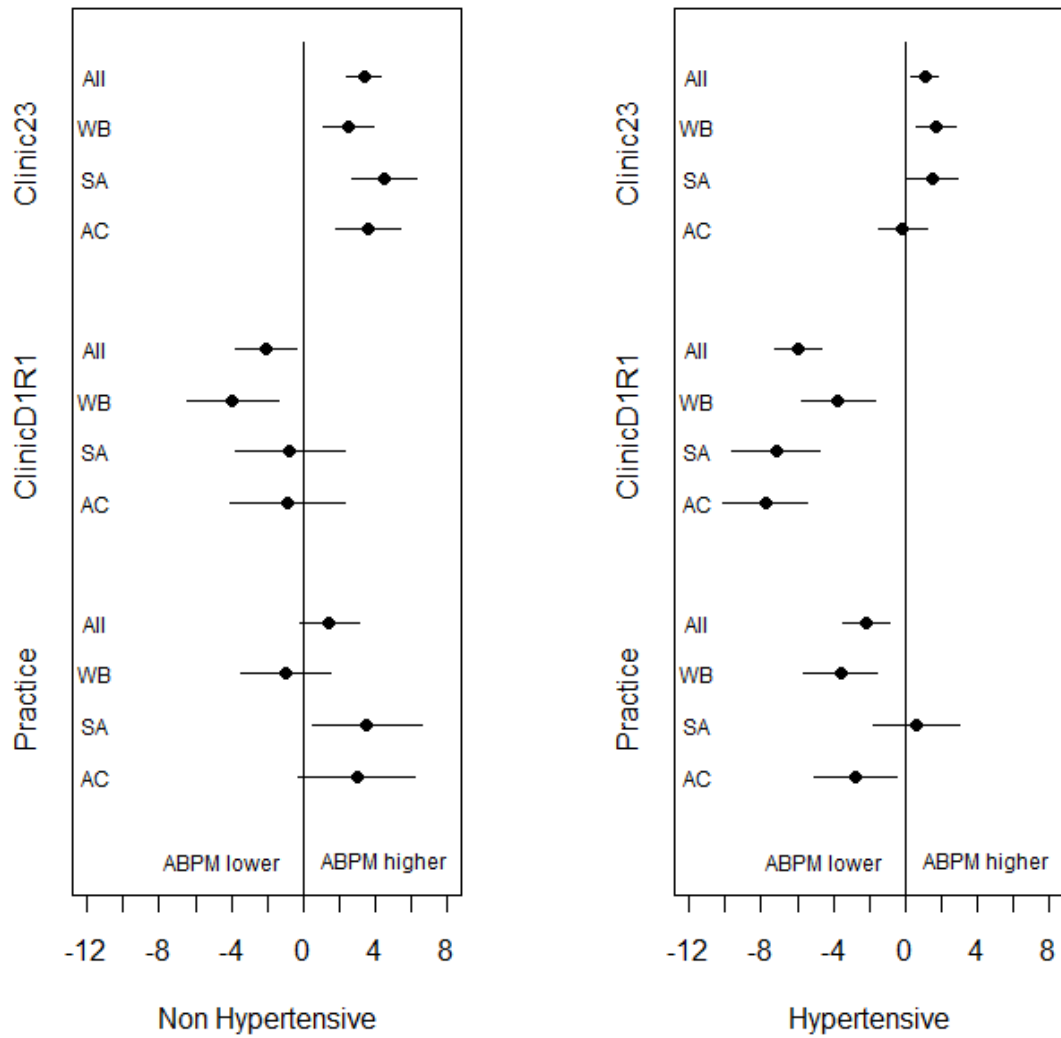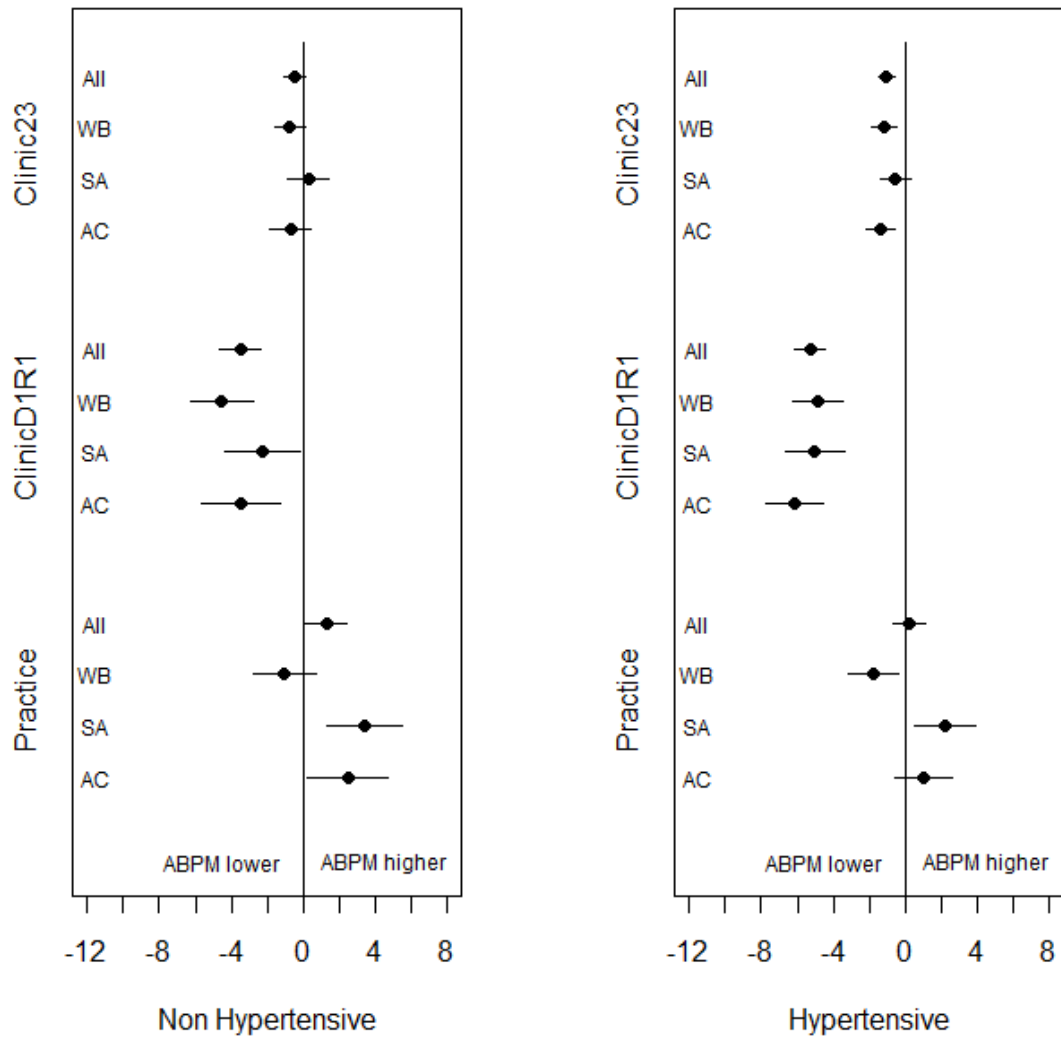**Figure 1**

Figure 2

**Comparison with ABPM**
Diastolic BP

**Figure 3**