



Antihypertensive Medication Category Prescriptions and Blood Pressure Control in African Surinamese and Ghanaian Migrants with Hypertension in Amsterdam, The Netherlands: The HELIUS Study

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Abstract

West African (WA) migrants in Europe have higher hypertension rates than the host populations. For African migrants, guidelines recommend diuretics and/or calcium channel blockers (CCB) for primary cardiovascular disease prevention, but data on antihypertensive medication (AHM) prescription patterns or related hypertension control rates are lacking. We assessed AHM prescription patterns and its relation to hypertension control among hypertensive WA migrants in the Netherlands compared to the host population. Cross-sectional data from WA or Dutch origin participants from the HELIUS study were used. Participants with treated hypertension and without diabetes, cardiovascular disease, or microalbuminuria were selected. We used logistic and linear regression analyses to assess the association between AHM categories and hypertension control rates (systolic blood pressure (BP) ≤ 140 mmHg and diastolic BP ≤ 90 mmHg) and the systolic BP levels. We compared 999 WA participants and 314 Dutch participants. Hypertension control rates were lower in the WA origin compared to Dutch origin participants (44.3% versus 58.0%, $p < 0.001$). For WA participants, prescription rates for any AHM category were: CCB (54.8%), diuretics (18.5%) beta-blocking agents (27.3%) and renin-angiotensin system blockers (52.6%). Prescription rates were higher for CCB and similar for diuretics compared to the Dutch participants. Neither CCB nor diuretics were associated with better control rates. Compared to Dutch participants, West African participants had similar diuretic prescriptions but significantly higher prescriptions for CCB. However, neither medications was associated with better hypertension control. Future research should explore physician and patient factors to improve hypertension control.

Keywords Hypertension · Blood pressure · Antihypertensive agents · Ethnicity · HELIUS study

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1 Introduction

Cardiovascular disease (CVD) is the leading cause of death globally, with hypertension as its most important risk factor [1, 2]. West African (WA) migrants in Europe have higher rates of hypertension than European host populations [3–7]. CVDs, including stroke and chronic kidney disease, are more prevalent among WA migrants than the host populations [8, 9]. Optimising hypertension control is important to reduce cardiovascular events and premature deaths [10]. As of January 1, 2023, 1.15 million (6.5%) of the 17.81 million inhabitants in the Netherlands were either born in Suriname or Africa, or had one or two parents who were [11]. In Amsterdam this percentage rises to 21% [12]. Strikingly lower hypertension control rates have been observed in African migrants than in the Dutch host population despite higher awareness and treatment levels [5]. Factors related to this disparity include socioeconomic, environmental and lifestyle factors [6]. Physiological factors that may contribute to higher BP levels include greater salt retention [13] and higher vascular contractility [14]. Differences in healthcare access may also contribute [6]. In the Netherlands, the health insurance system is universal: all residents are required to purchase statutory health insurance from private insurers, who must accept all applicants [15]. In West Africa, countries continue to face challenges in implementing and sustaining effective health insurance systems. Despite years of efforts from governments and the private sector, high out-of-pocket healthcare costs persist, limiting access to care and pushing many below the poverty line [16]. African migrants in the Netherlands face barriers to healthcare access, including communication difficulties, mistrust, and a preference for prescription-based care. However, their perception of the Dutch healthcare system as more beneficial than that of their country of origin helps mitigate these challenges [17].

Guideline recommendations on antihypertensive medication (AHM) for treating primary hypertension in individuals with an African background vary [18]. Guidelines recommend prescribing calcium channel blockers (CCB), diuretics, alone or in combination with an angiotensin receptor blocker as first-line pharmacological therapy [19–21]. The Dutch cardiovascular prevention guideline recommends either a diuretic or a CCB [22]. In a systematic review on the treatment of uncomplicated primary hypertension, these medications demonstrated higher BP-lowering efficacy and fewer side effects than other AHM categories, including renin-angiotensin system (RAS) blockers or beta-blocking agents (BB) [23]. The mechanisms of these differences in response to AHM in these WA descent groups are not fully understood. However, decreased efficacy of RAS blocking agents due to suppressed RAS activity and pharmacokinetic

variations, including cytochrome P450 polymorphisms, may play a role [24, 25]. For other ethnicities, BP-lowering efficacy is considered equal among AHM types [19–22].

Whether AHM prescription patterns across these hypertensive WA patients are consistent with the national guideline and whether recommended AHM are associated with better hypertension control compared to the host population is largely unknown. Therefore, to address these knowledge gaps, we assessed AHM prescription patterns and its relation to hypertension control among hypertensive WA migrants in the Netherlands compared to the host population.

2 Methods

2.1 Study Population and Design

We used baseline data from the Healthy Life in an Urban Setting (HELIUS) study. Full details, including study rationale and design, have been described elsewhere [26]. In short, HELIUS is a large prospective cohort study on health and healthcare utilisation among the largest ethnic groups living in Amsterdam, the Netherlands. Baseline data collection was conducted between January 2011 and November 2015, including participants aged 18–70 years from Surinamese, Turkish, Moroccan, Ghanaian, and Dutch origin. All participants were randomly selected, stratified by ethnic background, through the municipality registry of Amsterdam to generate comparable group sizes. Out of the 90,019 persons invited, we successfully contacted and received a response from 55% (49,952/90,019), either through a written invitation or a home visit by an interviewer. Of those, 50% (24,789/49,952) agreed to participate, corresponding to a response rate of 28%, with variation across ethnic groups: 54% for Dutch, 41% for Surinamese, and 39% for Ghanaian participants. Data collection consisted of a questionnaire/interview and physical examination at the research location, including the collection of biological samples. The Medical Ethics Committee of the Academic Medical Center approved the study protocols and this study was conducted in accordance with the ethical principles of the Declaration of Helsinki. All participants provided written informed consent. In total, 22,164 participants completed the questionnaire and had a physical examination. As the Dutch cardiovascular prevention guideline recommends specific AHM for individuals with a history of diabetes (2,394 [11%]), CVD (1,157 [5%]) or albuminuria (1,132 [5%]) [22], we excluded participants with these conditions. For this analysis, we selected participants treated with AHM, of whom 999 were of WA descent and 314 were of Dutch origin, to allow for comparison, leaving a sample of 1,313 for the analyses (Supplementary Fig. 1).

3 Measurements and Definitions

A person was classified as being of non-Dutch ethnic origin if they met either of two criteria: (1) he/she was born outside the Netherlands and has at least one parent born outside the Netherlands (first generation) or (2) he/she was born in the Netherlands but both parents were born outside the Netherlands (second generation). For the Dutch sample, people who were born in the Netherlands and whose parents were born in the Netherlands were invited. A limitation of the country of birth indicator for ethnicity is that people born in the same country might still have a different ethnic background, which in the Dutch context applies to the Surinamese population. Therefore, after data collection, participants of Surinamese ethnic origin were further classified according to self-reported ethnic origin (obtained by questionnaire) into 'African', 'South-Asian', 'Javanese', or 'other' [26]. Participants were asked to bring their prescribed medications to the research location, which were then categorised using Anatomical Therapeutic Chemical (ATC) classification system. For AHM, we included diuretics (C03), BBs (C07), CCBs (C08), and RAS-blockers (C09) [27]. The number of AHM categories was defined as the sum of different AHM categories used per participant, as the Dutch cardiovascular risk management guideline recommends a stepped protocol of subsequent low-dose AHM categories until the blood pressure is sufficiently controlled [22]. BP was measured twice on the left arm in a seated position after the subject had been seated for at least 5 min, using a validated automated digital BP device (Microlife WatchBP Home, Microlife AG, Heerbrugg, Switzerland). The mean of the two measurements was used in the analyses. Hypertension control was defined as systolic BP (SBP) ≤ 140 mmHg and diastolic BP (DBP) ≤ 90 mmHg. Educational attainment was used as an indicator of socioeconomic status (SES). Level of education was based on the highest qualification achieved either in the Netherlands or in the country of origin and was classified into four groups: low (no schooling or elementary schooling only), medium-low (lower vocational/secondary schooling), medium-high (intermediate vocational schooling or intermediate or higher secondary schooling), and high (higher vocational schooling or university). Obesity was based on a BMI ≥ 30 kg/m². Current smoking was based on self-report. Participants were classified as having diabetes based on self-reported diabetes, using glucose-lowering medication or a fasting plasma glucose level ≥ 7.0 mmol/L, according to the WHO criteria [28]. History of CVD was defined as self-reported myocardial infarction, coronary or peripheral revascularisation or previous cerebrovascular event. Albuminuria was defined as > 3 mg/mmol albumin/creatinin ratio [22]. Available data on therapy adherence were defined binary as participants

self-reportedly taking their AHM 7 days per week or less. However, as $> 90\%$ of participants reported therapy adherence, we considered this unsuitable for analyses.

3.1 Statistical Analysis

Throughout our analyses, we compared WA migrants to the Dutch host population. We used descriptive statistics to determine AHM prescription patterns, the proportion of participants with hypertension control, and the mean systolic BP (SBP) level per AHM category. Multiple variate logistic regression was used to examine the association between AHM categories and hypertension control, and multiple variate linear regression was used to examine the association between AHM categories and SBP independently. Three models were used to examine the data for both logistic and multiple linear regression. Odds ratios (OR) and unstandardised regression coefficients (β) were reported. The first model was unadjusted. Model 1 adjusted for sex, age, educational level, and obesity, as previous research in this cohort demonstrated that obesity is independently associated with uncontrolled hypertension [29]. Model 2 additionally adjusted for multiple AHM use, defined as being prescribed more than one AHM category. First, we assessed the association between AHM and hypertension control and BP levels in three groups: 1) those using CCB and/or diuretics, 2) BB and/or RAS, or 3) any other combination (e.g., CCB and RAS) to attain mutual exclusiveness between these groups. We used the BB and/or RAS group as the reference group as we expected this group to be least associated with hypertension control. Subsequently, we assessed the associations for all four individual AHM categories with hypertension control in our regression models. These individual AHM categories were not mutually exclusive, as participants could have been prescribed several AHM categories. To account for this, we adjusted for multiple AHM use in the final regression model. Interaction analyses between recommended AHM types (CCB/diuretics) and hypertension control was significant for WA ethnicity ($p = 0.08$). Once stratified for WA ethnicity interaction analyses for sex, age (continuous), education level, and WA subgroup (African Surinamese and Ghanaian) were not significant ($p > 0.10$) (Supplementary Table 1). Because there are reports of differences in AHM effectiveness across African populations, we additionally conducted exploratory analyses stratified for Ghanaian and African Surinamese ethnicity [30, 31]. Similarly, as sex differences have been reported in AHM prescription patterns, we conducted exploratory analyses stratified by sex [32]. All analyses were performed in RStudio version 4.0.3 [33].

Table 1 Sample characteristics

	West African participants (N=999)	Dutch participants (N=314)
Women (%)	696 (69.7)	190 (60.5)
Age (years)	53.73 (7.56)	58.24 (8.93)
Education level (%)		
Low	171 (17.3)	20 (6.4)
Medium-low	412 (41.7)	105 (33.8)
Medium-high	270 (27.3)	68 (21.9)
High	135 (13.7)	118 (37.9)
African-Surinamese ethnicity (%)	596 (59.7)	-
Ghanaian ethnicity (%)	403 (40.3)	-
SBP (mmHg)	141.36 (17.01)	135.86 (15.95)
DBP (mmHg)	87.62 (10.24)	83.06 (9.72)
SBP ≤ 140 mmHg and DBP ≤ 90	443 (44.3)	182 (58.0)
Obesity (BMI ≥ 30) (%)	411 (41.1)	100 (31.8)
Current smoking (%)	164 (16.4)	69 (22.0)
Number of AHM		
One	579 (58.0)	207 (65.9)
Two	322 (32.2)	87 (27.7)
Three	85 (8.5)	19 (6.1)
Four*	13 (1.3)	1 (0.3)
Mean number of AHM (number)	1.53 (0.7)	1.41 (0.6)
CCB	547 (54.8)	60 (19.1)
Diuretics	185 (18.5)	52 (16.6)
BB	273 (27.3)	135 (43.0)
RAS	525 (52.6)	195 (62.1)

N, number of participants, AHM, antihypertensive medication, SBP, systolic blood pressure, DBP, diastolic blood pressure, CCB, calcium channel blockers, BB, beta-blockers, RAS, renin-angiotensin system blockers

*No participants were prescribed > 4 AHM

4 Results

Characteristics of the study population are presented in Table 1. Of WA participants, 59.7% were of Ghanaian and 40.3% of African Surinamese (AS) ethnicity; most participants were female (69.7%). Among those treated, hypertension control rates were lower in the WA group than in

the Dutch population (respectively 44.3% and 58.0%, $p < 0.001$). A higher proportion of WA participants were prescribed two or more different BP lowering drugs, than the Dutch participants, respectively 42.0% and 34.1%. Table 2 presents prescription patterns and associated hypertension control rates and SBP levels. In the WA population, participants were roughly equally distributed across the three categories of BB/RAS, CCB/diuretics, and other combinations, with no clear differences in hypertension control rates. In the Dutch participants, most were prescribed BB/RAS. CCB prescription rates were higher in the WA population (54.8%) compared to the Dutch population (19.1%), but diuretics prescription rates were similar (18.5%) compared to the Dutch participants (16.6%). Similar prescription rates were observed in participants using monotherapy (Fig. 1).

Table 3 shows the association between AHM category and hypertension control. No significant differences in hypertension control between AHM categories were observed in both the WA and Dutch participants. Table 4 presents the results of multiple linear regression for AHM categories and SBP. No significant associations between AHM categories and SBP levels were observed in fully adjusted models. In explorative analyses stratified for WA ethnicity, being prescribed BBs was significantly associated with higher SBP levels in Ghanaian participants (mean difference 8.82 mmHg, 95% CI 3.60;14.05, $p < 0.001$), but not in African Surinamese participants (mean difference -1.85 mmHg, 95% CI -6.97;3.27) (Supplementary Table 3).

In explorative sex stratified analyses, no significant differences between AHM and hypertension control were observed. Being prescribed CCB/diuretics or both was associated with a lower SBP (mean difference -3.36 mmHg, 95% CI -6.39;-0.33, $p = 0.03$) and BB with a higher SBP (5.18, 95% CI 0.31;10.05, $p = 0.04$) in WA women (Supplementary Tables 4–5).

Table 2 Mean systolic blood pressure (mmHg) and hypertension control rates per antihypertensive medication category

	West African (N=999)			Dutch (N=314)		
	N	SBP	Hypertension control	N	SBP	Hypertension control
BB and/or RAS	346 (34.6%)	141.85 (± 17.8)	154 (44.5%)	209 (66.6%)	135.59 (± 16.0)	125 (59.8%)
CCB and/or diuretics	323 (32.3%)	140.00 (± 14.9)	145 (44.9%)	37 (11.8%)	137.51 (± 17.4)	17 (45.9%)
Other combinations	330 (33.0%)	142.18 (± 18.0)	144 (43.6%)	68 (21.7%)	135.79 (± 15.1)	40 (58.8%)
CCB	547 (54.8%)	141.56 (± 16.7)	236 (43.1%)	60 (19.1%)	136.51 (± 15.6)	32 (53.3%)
Diuretics	185 (18.5%)	139.57 (± 16.5)	86 (46.5%)	52 (16.6%)	135.97 (± 15.6)	29 (55.8%)
BB	273 (27.3%)	143.81 (± 19.3)	112 (41.0%)	135 (42.3%)	135.34 (± 16.0)	81 (60.0%)
RAS	525 (52.6%)	141.94 (± 18.0)	239 (45.5%)	195 (62.1%)	135.77 (± 15.7)	113 (57.9%)

N, number of participants, hypertension, hypertension, SBP, systolic blood pressure, CCB, calcium channel blockers, BB, beta-blockers, RAS, renin-angiotensin system blockers

*Single antihypertensive medication categories are not mutually exclusive

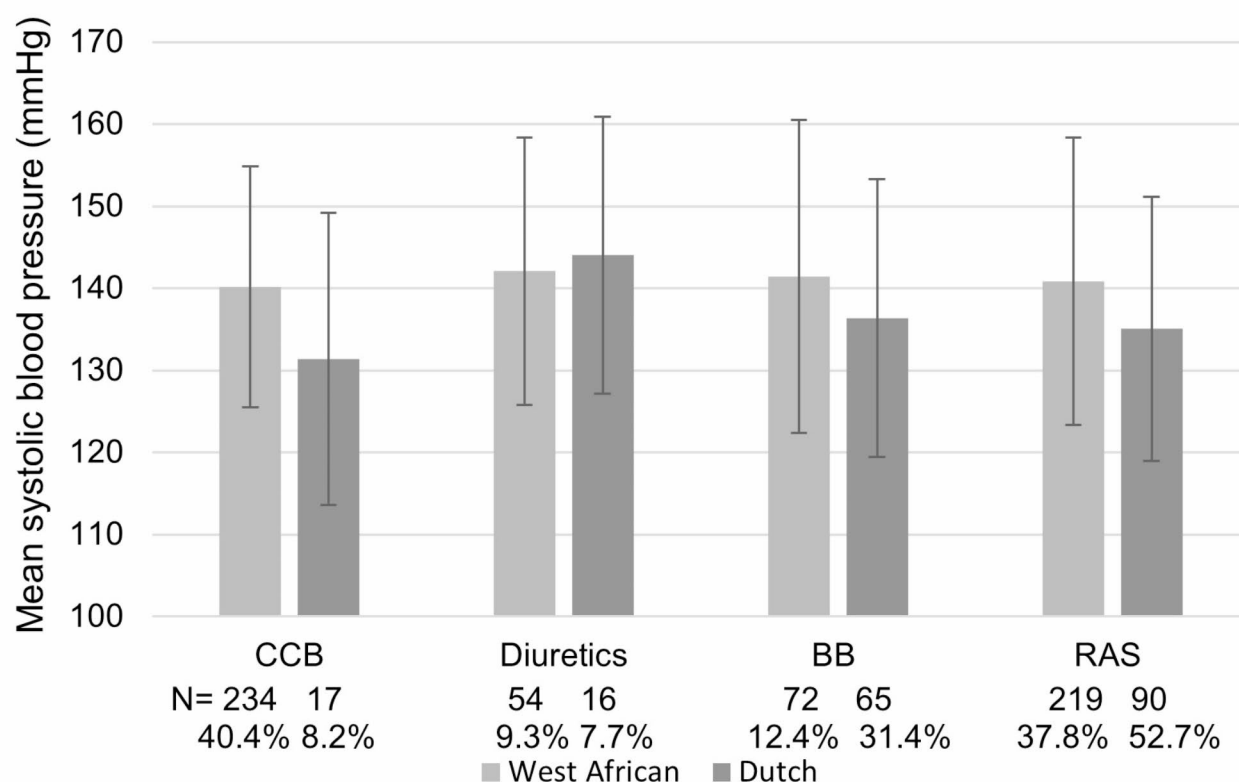


Fig. 1 Mean systolic blood pressure (mmHg) per antihypertensive medication category in participants using monotherapy. Legend: N = number of participants, CCB, calcium channel blockers, BB, beta-blockers, RAS, renin-angiotensin system blockers

Table 3 (adjusted) odds ratio's (95% confidence intervals) for hypertension control with antihypertensive medication categories versus (BB and/or RAS) or other antihypertensive agents

	West African (N=999)			Dutch (N=314)		
	Unadjusted OR (95% CI)	Model 1 aOR (95% CI)	Model 2 aOR (95% CI)	Unadjusted OR (95% CI)	Model 1 aOR (95% CI)	Model 2 OR (95% CI)
BB and/or RAS	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
CCB and/or diuretics	1.02 (0.75;1.38)	1.06 (0.78;1.46)	1.06 (0.77;1.45)	0.57 (0.28;1.15)	0.52 (0.24;1.08)	0.50 (0.24;1.05)
Other combinations	0.97 (0.71;1.31)	1.17 (0.85; 1.61)	1.22 (0.74;2.04)	0.96 (0.55;1.69)	1.27 (0.70;2.33)	1.78 (0.77;4.15)
CCB	0.90 (0.69;1.19)	1.08 (0.81;1.43)	1.11 (0.68;1.79)	0.81 (0.45;1.45)	0.94 (0.51;1.74)	1.31 (0.44;4.10)
Diuretics	1.13 (0.81;1.57)	1.21 (0.86;1.70)	1.24 (0.77;1.98)	0.90 (0.49;1.68)	1.04 (0.54;2.03)	1.41 (0.49;4.33)
BB	0.82 (0.61; 1.09)	0.89 (0.66;1.21)	0.92 (0.58;1.44)	1.13 (0.68;1.90)	1.18 (0.69;2.04)	1.62 (0.59;4.76)
RAS	1.07 (0.82;1.41)	1.20 (0.90;1.59)	1.23 (0.76; 1.99)	1.02 (0.60;1.73)	1.23 (0.70;2.16)	1.68 (0.60;4.99)

N = participants using any antihypertensive agent, OR, odds ratio, aOR, adjusted odds ratio, CI, confidence interval, CCB, calcium channel blockers, BB, beta-blockers, RAS, renin-angiotensin system blockers

Model 1: sex, age, educational attainment and obesity (BMI ≥ 30)

Model 2: model 1 + multiple antihypertensive agents use

*Single antihypertensive medication categories are not mutually exclusive

5 Discussion

We examined AHM prescription rates and their association with hypertension control and BP levels among WA and Dutch participants of a multi-ethnic cohort in Amsterdam.

Compared to the Dutch participants, prescriptions for diuretics were similar, whereas those for CCB were much higher in WA participants, suggesting that ethnicity is taken into account when prescribing BP lowering medication. Hypertension control rates were similar between individuals

Table 4 Differences in blood pressure levels (mmHg) between users of antihypertensive medication categories versus other antihypertensive agents

	West African (999)			Dutch (N=314)		
	Unadjusted	Model 1 adjusted	Model 2 adjusted	Unadjusted	Model 1 adjusted	Model 2 adjusted
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
BB and/or RAS	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
CCB and/or diuretics	-1.84 (-4.42; 0.74)	-2.19 (-4.72; 0.35)	-2.12 (-4.66; 0.42)	1.92 (-3.69; 7.35)	2.57 (-2.90; 8.04)	2.57 (-2.92; 8.06)
Other combinations	0.33 (-2.24; 2.90)	-1.37 (-3.92; 1.19)	-2.68 (-6.72; 1.37)	0.20 (-4.19; 4.59)	-2.52 (-6.89; 1.85)	-2.51 (-8.74; 3.72)
CCB	1.26 (-1.03; 3.54)	-0.27 (-2.55; 2.01)	0.36 (-3.46; 4.18)	0.51 (-4.18; 5.20)	-1.14 (-5.70; 3.42)	-2.98 (-11.02; 5.07)
Diuretics	-1.89 (-4.69; 0.91)	-2.44 (-5.19; 0.31)	-1.91 (-5.69; 1.87)	-0.08 (-5.01; 4.85)	-1.98 (-6.90; 2.93)	-3.69 (-11.56; 4.18)
BB	3.86 (1.45; 6.27)*	2.27 (0.37; 5.17)*	3.32 (-0.28; 6.92)	-1.14 (-5.22; 2.94)	-2.17 (-6.16; 1.83)	-3.95 (-11.53; 3.62)
RAS	1.65 (-0.63; 3.94)	0.61 (-1.66; 2.89)	1.25 (-2.58; 5.07)	-0.67 (-4.87; 3.53)	-2.61 (-6.78; 1.56)	-4.39 (-12.05; 3.27)

N = participants using any antihypertensive agent, SBP, systolic blood pressure, β , beta score, CI, confidence interval,

CCB, calcium channel blockers, BB, beta-blockers, RAS, renin-angiotensin system blockers

Model 1: sex, age, educational attainment and obesity (BMI ≥ 30)

Model 2: model 1 + multiple antihypertensive agents use

* $p < 0.05$

**Single antihypertensive medication categories are not mutually exclusive

prescribed AHM recommended by the national guideline and those prescribed other AHM. Despite a higher proportion of WA participants prescribed two or more different BP lowering drugs compared to Dutch participants, hypertension control rates were poorer.

Since 2006, the Dutch national guidelines have recommended diuretics and CCB for cardiovascular risk management in people of WA descent, with no preference between these two medication categories [22, 34]. Therefore, we expected similar prescription rates for diuretics and CCB, but diuretics description rates were much lower. A study from 2003 among Dutch general practitioners found that they base their choice of AHM on experience with the drug, guideline recommendations, costs, efficacy and how well the drug is tolerated [35]. These factors could play a role in the AHM drug of choice for the prescribers in the region where this study was performed. For instance, larger BP reductions have been observed for CCB than diuretics among patients of African descent [36]. Convenience may also play a role, as the Dutch guideline recommends blood tests to check electrolytes and kidney functions before starting diuretics and annually thereafter. However, there is no such recommendation for CCB [22]. Furthermore, physicians previously expressed concerns that hypertensive patients of African descent would not sufficiently benefit from the renoprotective effects of RAS agents. They felt these potential benefits outweighed the possibly higher BP-lowering efficacy of CCB and diuretics [37].

Overall, associations between AHM categories with hypertension control and BP were comparable between the WA and Dutch populations. This similarity is supported by a previous meta-analysis showing that white Americans and African-Americans respond largely similar to commonly prescribed AHM [38]. Still, among WA participants,

associated BP levels with BBs and RAS-blockers were generally higher than in Dutch participants, although this did not reach statistical significance, possibly due to a lack of power. Higher associated BP levels are in line with previous reports that these AHM are not as effective in populations of African descent compared to those of European descent [39]. Ethnic differences in BP-lowering responses to AHM may be partly explained by higher salt sensitivity in Sub-Saharan African populations compared to European populations leading to a higher BP rise to salt intake and a lower, or even suppressed RAAS activity [40], which may lower the BP-lowering response to agents acting on RAS such as RAS-blockers and BB. Another explanation may be cytochrome P450 polymorphisms, as this enzyme handles most AHM categories, including BBs, CCBs and RAS-blockers, but not diuretics, which are renally eliminated [41]. Such polymorphisms, particularly CYP1A2, lead to increased inducibility and thereby cause lower biological drug availability and are highly prevalent among ethnic groups of African origin [25]. Admixture analysis in the HELIUS cohort indicated greater genetic diversity among African Surinamese participants compared to Ghanaian participants. African Surinamese showed a broader range of ancestral admixture, with significant contributions from African, Asian, and European populations, leading to more dispersed genetic clustering. In contrast, the Ghanaian group showed less admixture and greater genetic homogeneity [42]. In explorative analyses stratified for WA ethnicity, being prescribed BBs was associated with higher SBP in Ghanaian, but not in African Surinamese participants. Potential explanations include differences in AHM adherence, polymorphisms in genes related to metabolising BBs [41], or unaccounted confounding factors such as use of other medications interacting with BBs. Therefore, differences in AHM lowering

efficacy, particularly BBs, among African ethnicities cannot be ruled out and studies with larger participant samples are necessary to establish or refute this. We found modest differences in AHM categories and associated BP levels between WA men and women. The lower SBP levels associated with CCBs/diuretics compared to other AHM in WA women is attributed to the reference group 'other AHM', which encompassed BBs, as in separate AHM analyses BBs were associated with significantly higher SBP levels than the other AHM. This may be explained by random variability given the limited sample size, unaccounted characteristics (e.g. use of medications interacting with BBs), differential prescribing patterns (i.e. if BB are more commonly prescribed compared to other AHM to WA women for specific reasons), or differences in AHM adherence [32, 43].

Overall, our findings suggest that hypertension control rates are lower among WA participants than the Dutch participants and that existing prescription patterns among WA migrant populations may not sufficiently lead to a similar level of control of hypertension between ethnic groups. One possible explanation is that over half of the participants were prescribed monotherapy instead of multiple agents, representing an important window of opportunity for improving hypertension control. As previously suggested, intensifying BP-lowering therapy by combining categories of AHM may be more beneficial than focusing on optimising monotherapy for hypertensive patients of African descent [44, 45]. Moreover, when comparing different dual therapy combinations in lowering BP in Americans of African descent, it was found that CCB with either hydrochlorothiazide or angiotensin-converting enzyme inhibitor (ACEi) were more effective in lowering BP than ACEi and hydrochlorothiazide [45]. However, we could not replicate these findings in our study population as we had no data on diuretic types, and the numbers of participants being prescribed these combinations were too low (Supplementary Table 6).

5.1 Strengths and Limitations

A strength of this study is that all socioeconomic levels are represented in the HELIUS study, enhancing the generalisability of our results to the general population [26]. Several limitations need to be taken into account. Firstly, selection bias may have played a role, even though previous analyses have shown that differences between participants and non-participants in HELIUS were limited [26]. Secondly, we used a cross-sectional design, which allows for describing associations rather than comparing BP lowering efficacy between AHM categories. Thirdly, to attain large enough group sizes for analyses, we combined Ghanaian and African Surinamese participants into one WA group as cardiovascular guidelines give uniform recommendations for all

people of WA descent, regardless of country of origin. In the Dutch context, African Surinamese and Ghanaians are different in migration history and communication languages (Dutch and English) [26], potentially influencing patient physician interaction. Despite the absence of significant interaction between both African populations in our sample, there have been reports of differences in AHM effectiveness across African populations [30, 31]. Dietary habits and physical activities levels may also differ across these populations. Therefore, future studies with larger sample sizes to allow for stratification based on varying African ethnicities may provide further insights into potential differences in AHM effectiveness. Additionally, data were lacking on physicians' considerations on choices for specific AHM. Data on previous AHM use, pretreatment BP levels, more detailed information on treatment adherence, specific drug combinations, potential side effects, dosage, or duration of treatment, as well as other considerations of physicians who issued the prescriptions, would be valuable in understanding prescription behaviour and reducing potential confounding bias. Future qualitative research among AHM prescribers may aid our understanding of current prescription patterns.

6 Conclusion

Compared to Dutch participants, West African participants had similar diuretic prescriptions but significantly higher prescriptions for CCB. However, neither medications was associated with better hypertension control. Despite a higher proportion of WA participants who were prescribed two or more different BP lowering drugs, than the Dutch participants, hypertension control rates were poorer. Future research should explore physician and patient factors to improve hypertension control. Since most WA participants were prescribed monotherapy, exploring combinations of AHM could enhance hypertension control among those groups. Direct head-to-head clinical trials may offer insights regarding effecting AHM combinations to enhance the control of hypertension among WA migrants residing in Europe.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s40292-024-00690-w>.

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Data Availability The data used for this study are part of the HELIUS study and are not publicly available. The HELIUS data are owned by the Amsterdam UMC in Amsterdam, the Netherlands. Researchers can request the data by submitting a proposal to the HELIUS Executive Board as outlined at <http://www.heliusstudy.nl/en/researchers/collaboration>. Requests for further information and proposals can be submitted to HELIUS's scientific coordinator (heliuscoordinator@amsterdamumc.nl). The HELIUS Executive Board will check proposals for compatibility with the general objectives, ethical approvals and informed consent forms of the HELIUS study and potential overlap with ongoing work affiliated with HELIUS. There are no other restrictions to obtaining the data; all data requests will be processed similarly.

Code Availability R-scripts used for the current analyses will be shared on reasonable request.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Ethics Approval The Medical Ethical Committee of the Academic Medical Center approved the study protocols of the HELIUS study.

Consent for Publication Not applicable.

Consent to Participate All participants provided written informed consent before participating.

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