Received: 17 August 2025 | Revised: 8 September 2025 | Accepted: 14 September 2025

DOI: 10.1002/bcp.70314

THEMED ISSUE ARTICLE

# Nonadherence and uncontrolled arterial hypertension in Croatia—Insights from the *May Measurement Month 2023* campaign and *Hunting the silent killer* programme

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**Funding information**
This study was supported by an unrestricted research grant of the Croatian Hypertension League, and equipment/devices for the blood pressure measurements were donation of the Salvus Company.

**Aims:** To determine the prevalence of non-adherence to antihypertensive medicines and to identify demographic and behavioral factors associated with non-adherence in subjects enrolled in the May Measurement Month (MMM) 2023, as part of the permanent public health action *Hunting the silent killer*.

**Methods:** In this cross-sectional opportunistic screening, the original MMM questionnaire was extended by adding questions related to salt intake, mobile phones, and adherence, which was assessed using the validated 5-item Medication Adherence Report Scale (scores ≥23 indicating adherence). Out of 10 488 subjects enrolled in MMM 2023 in Croatia, this analysis included 8739 subjects who were enrolled in 329 community pharmacies and had three BP measurements using the same device.

**Results:** Among 4964 HT participants, 68.2% were adherent. Non-adherence was more common among men, urban residents, and younger individuals. Female sex (OR = 1.29) and rural residence (OR = 1.21) were associated with higher adherence. Non-adherence was significantly associated with poorer BP control ($p < 0.05$). Forgetfulness and missing doses were the most frequently reported behaviors.

**Conclusion:** Nearly one-third of HT patients in Croatia are nonadherent to prescribed medicines, contributing to suboptimal BP control. Routine adherence screening and tailored interventions, particularly for younger men and urban dwellers, are urgently needed to improve cardio-kidney-metabolic outcomes.

KEYWORDS
arterial hypertension, blood pressure control, MARS-5, medication adherence, MMM campaign

Valerija Bralić Lang and Ana Soldo contributed equally to this work.

## 1 | INTRODUCTION

Arterial hypertension (HT) is the most prevalent modifiable risk factor for cardiovascular disease worldwide. It is the leading cause of death and the most common contributor to disability-adjusted life years.[1] In Croatia, HT is the leading public health issue. According to preliminary results from the national Epidemiology of Hypertension in Croatia (EH-UH) 2 study, the crude prevalence of HT is increasing, placing Croatia among the countries with the highest rates in Europe.[2] Furthermore, HT ranks as the second leading cause of death in Croatia overall and the first among women, with a growing trend in mortality attributable to hypertensive disease in recent years.[3] Despite the availability of effective pharmacological therapies, blood pressure (BP) control rates in Croatia remain suboptimal, which is already reported for similar middle-income countries.[4] As Croatia lacks a national programme for this main health problem, the Croatian Hypertension League (CHL) in 2019 has started a permanent public health programme 'Hunting the silent killer' aiming to increase health literacy and to alert the government and policy-makers within Croatia's healthcare system.[5] Two years ago, CHL intensified activities with two sister actions 'Mission 70/26' with the aim to obtain BP control in 70% of treated hypertensive patients till 2026, and 'What is your number' with the primary aim to increase awareness about cholesterol.[6] Poor adherence to antihypertensive therapy is a main barrier to effective BP control. Globally, it is estimated that between 30% and 50% of patients with chronic noncommunicable diseases (NCD) fail to take their medicines as prescribed.[7,8] This poor adherence is not only a common cause of therapeutic failure in HT management but also a modifiable risk factor that is frequently underestimated in clinical practice.[9] It is linked to hundreds of thousands of deaths and annual costs of several hundred billion euros in Europe. Enhancing medication adherence improves clinical outcomes, while reducing the financial and environmental burden on health systems. The recent European Society of Hypertension (ESH) guidelines recommended screening for nonadherence in all patients with apparent resistant hypertension or those who are on combination (at least two drugs) therapy.[10] Physicians or pharmacists in community pharmacies should collect information on adherence being aware that all methods have limitations, and multidimensional team-based care is recommended. It was also stated that community pharmacies, because of their proximity and accessibility, may be suitable places to provide health education contributing to HT management and increase of BP control. Given the magnitude of the problem, identifying adherence patterns and associated factors in the Croatian population is crucial. However, large-scale national data on adherence in Croatia are missing, and standardized tools are not routinely used in primary care settings to assess this critical determinant of treatment success. This study was part of the May Measurement Month (MMM) 2023 campaign and the Hunting the silent killer programme aiming to assess the prevalence of adherence to antihypertensive medicines and to measure adherence in a standardized and interpretable manner in community pharmacies across Croatia.

## 2 | METHODS

### 2.1 | Study design, setting and recruitment

This study was a part of the MMM 2023, a cross-sectional opportunistic study, which was initiated in 2017 by the International Society of Hypertension, and in Croatia is organized as a part of the permanent public health programme 'Hunting the silent killer' by the CHL and the Croatian Chamber of Pharmacists. In MMM 2023 citizens were examined, educated and enrolled on various public places, hospitals and universities, but majority were recruited in 329 community pharmacists, in all 21 Croatian counties. Before the campaign started educative workshops were organized on how to apply structured electronic questionnaire and how to properly measure BP. Not only pharmacists but also volunteers participated in the MMM 2023 on various places, all members of the CHL, were trained in the same manner. Educative materials about proper BP measurements, healthy lifestyle (salt intake), sick day medication rules, adherence and so forth were prepared, printed and distributed to coworkers to be used as educative materials after applying the questionnaire and after the BP measurements. In total, 10 488 subjects older than 18 years were examined, and in this analysis, we included 8739 subjects who were recruited in community pharmacies and who had recorded all three values of BP measurements. All information was self-reported and fully anonymized for further processing. Data were coded and entered Excel electronically.

### 2.2 | Questionnaire

The questionnaire was applied prior to BP measurements (response rate 80.7%). We used the questionnaire which was extended from the original MMM version by adding questions about adherence, mobile phones usage and salt intake. To assess a patient's adherence to antihypertensive medicines we used the Medication Adherence Report Scale 5 (MARS-5, ©Professor Rob Horne), which is a 5-item version focused on intentional and unintentional nonadherence. A permission to use the Medication Adherence Report Scale 5 (MARS-5) was obtained from the author prior to the beginning of the study (on 18 October 2021). Initially, a pretest was conducted with 25 patients. We then used forward and backward translation by two independent translators, review by the Consensus Committee of the Croatian Hypertension League and the Croatian Chamber of Pharmacists, and a second pilot test with the target population for clarity and cultural appropriateness. This ensured that the translated questionnaire was linguistically accurate, culturally relevant and retained the psychometric properties of the original scale. The questions were read by members of research team (pharmacists, physicians and students) conducting the interview because MARS-5 questionnaire was incorporated into the globally electronically prepared MMM questionnaire. All members of research team were educated before the study. MARS-5 offers a structured, validated self-report instrument designed to evaluate both intentional and unintentional nonadherence.[11] This scale comprises items, which describe a range of nonadherent

behaviours, with items phrased in a nonthreatening and nonjudgmental way to normalize nonadherence, and a response scale that allows the categorization of patients in terms of their position along the 'adherence dimension' rather than on the basis of a 'yes/no' or 'high/low' dichotomous response, thus providing more detail and differentiation between individuals. It is a Likert 1–5 based scale (*Never* to *Always*), to gauge how often patients engage in behaviours like forgetting, altering dosage, stopping medication or taking less medication than prescribed. Higher scores on the MARS-5 generally indicate higher self-reported adherence.

## 2.3 | Measurements

BP was assessed according to the ESH guidelines and for all measurements an automated device Microlife BP B3® with the correct cuff size was used. Three readings of BP were recorded with a 1-min interval between measurements. BP was averaged from the final two of three readings. In case, BP was measured above systolic BP ≥140 mmHg and/or diastolic BP ≥90 mmHg, and/or the participant was taking antihypertensive medicines; the participant was labelled as hypertensive. Undiagnosed HT was defined as a high BP at the time of the screening event without a self-reported history of HT and untreated HT was defined as high BP without the use of antihypertensive medicines. Finally, BP was therapeutically controlled if systolic BP <140 mmHg and/or diastolic BP <90 mmHg under current antihypertensive medicines. Height and weight were self-reported or measured where services allowed it, and body mass index was calculated automatically.

## 2.4 | Variables

Possible determinants of adherence were selected a priori based on previous literature suggesting potential correlations with medication adherence.[7,11] We collected self-reported data on age, sex, place of residence, height, weight and smoking status (yes, no, never and before); alcohol consumption (1–3x per month, 1–6x per week, seldom or never, every day), physical activity (yes and no), eating habits, smartphone use, data of BP history (last time measured, HT duration and data on cardiovascular drugs) (antihypertensives, statins, aspirin, warfarin, number of drugs and paying status), comorbidities (myocardial infarction, stroke, atrial fibrillation, diabetes, chronic kidney disease and tachycardia) as well as self-reported regularity on taking the drug (yes and no) and reasons for irregular taking (unavailable, side effects, prefer alternative medicine, too expensive, taking only when I need and I forgot).

## 2.5 | Outcomes

Adherence was defined as scores 23–25 and nonadherence as scores 5–22 on MARS questionnaire. Behaviours were assessed as per MARS: taking less than prescribed, stopping medication for a period, missing a dose, adjusting the dose independently and forgetting to take medication. Each item was rated 1, *Never* to 5, *Always*.

## 2.6 | Reliability and validity testing

The MARS-5 questionnaire was evaluated in terms of its reliability (internal consistency and test–retest reliability) and validity (criterion-related and construct validity).

## 2.7 | Statistical methods

The sample size calculation was based on detecting a difference in mean systolic BP between adherent and nonadherent participants. Based on previous data, we assumed a standard deviation of 15 mmHg and a minimum clinically meaningful difference of 6 mmHg. Using a two-sided $\alpha = 0.05$ and 90% power, this yielded a required $n = 86$ per group (total $N = 172$) based on a two-sample *t*-test. To account for clustering within pharmacies, we applied a design effect: $\text{DEFF} = 1 + (m - 1) \times \text{ICC}$, assuming an average cluster size $m \approx 15$ and $\text{ICC} = 0.01$, which increased the sample requirement by ~14%. Allowing for 10% missing or invalid responses, the adjusted minimum target was approximately $N \approx 215$. The final enrolled sample ($N = 8739$) exceeded this threshold, increasing the precision of prevalence estimates and power for subgroup analyses. For adherence prevalence, this sample size yields a 95% confidence interval with a maximum margin of error of ±1.3%. It also provides >90% power to detect a Cronbach's α ≥0.70 for the 5-item MARS-5, supporting its reliability analysis. Data analysis was conducted using jamovi® version 2.6.26 computer software (open source). The normality of data distribution was tested with Kolmogorov–Smirnov test. Quantitative data were organized as medians with interquartile ranges (25th and 75th percentile). For two-group comparison, we applied the Mann–Whitney *U* test or the chi-square test for categorical variables and the Kruskal-Wallis test for three or more group analysis. Dwass–Steel–Critchlow–Fligner pairwise comparisons were used as a post hoc test. Validity of the scale was tested using Mann–Whitney test, which compared the association of participants who were low and high adherers according to cut-off score of adherence scale and their mean value of systolic and diastolic blood pressure. *P*-value <0.05 was considered significant for all the results.

# 3 | RESULTS

Out of a total of 8739 participants (63.3% women), 4964 (56.8%) had HT (22.6% untreated, 37.8% uncontrolled and 39.6% controlled). Medicine adherence was a key factor distinguishing controlled from uncontrolled HT ($p = 0.023$ and $p = 0.002$ for systolic and diastolic BP, respectively) (Figure 1). The internal consistency of the MARS-5 showed high reliability with Cronbach's α 0.764. Criterion-related validity was also established with more adherent HT patients showing

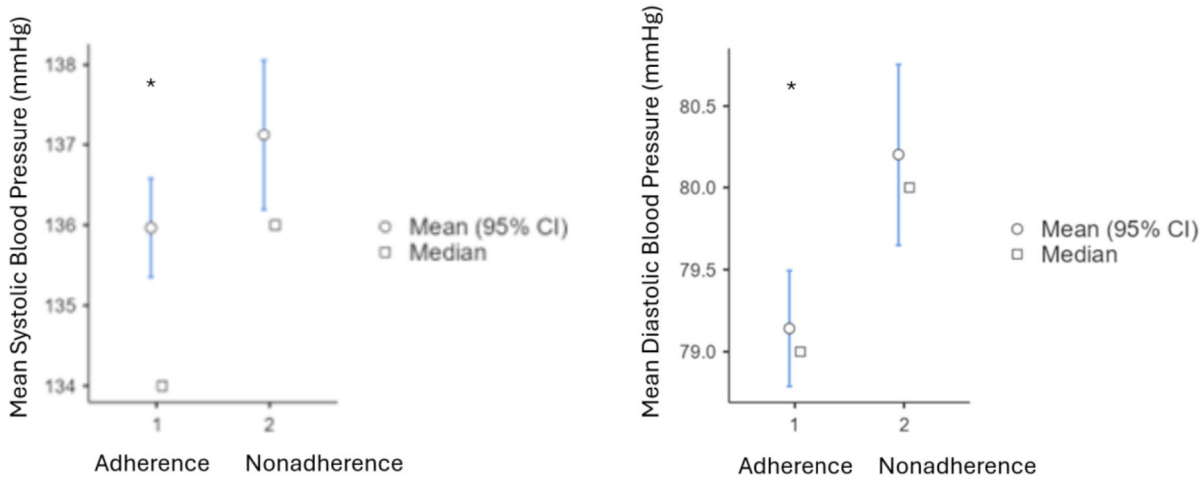


**FIGURE 1** Plots showing that more adherent hypertension patients achieve better blood-pressure control. *Mann–Whitney *U* test; $p = 0.023$ for SBP and $p = 0.002$ for DBP.

more BP control ($p = 0.023$ for systolic BP and $p = 0.002$ for diastolic BP) (Figure 2). The analysis of medication-taking behaviours between adherent and nonadherent individuals showed that nonadherent individuals scored lower across all items, especially in 'Taking less than prescribed' (3.60 *vs*. 4.97) and 'Missing a dose' (3.63 *vs*. 4.82) (Table 1). A detailed analysis of the MARS questionnaire revealed significant gender differences in various aspects of adherence behaviour. Thus, 57.3% of participants reported taking chronic medicines; men were slightly more likely to have prescribed chronic medication than women ($p = 0.004$). Overall, 31.8% of participants were classified as nonadherent, with women (29.7%) being significantly more likely to adhere to medicines than men ($p < 0.001$). Men consistently showed poorer adherence behaviour in almost all measured areas: missing doses, stopping treatment, forgetting and taking less than the prescribed dose. The only item with no gender difference was self-adjustment of medicine dose. To spot strengths and weaknesses in medication adherence per group a heat map of adherence behaviours across BP categories was performed (Figure 3). Patients with controlled BP consistently showed the highest adherence rates across all behaviours. Patients with uncontrolled BP had significantly lower adherence in key areas such as 'Never miss a dose' and 'Never forget'. Normotensive and untreated groups showed moderate adherence and lag slightly behind the controlled group. Logistic Regression Analysis revealed adherence predictors to be being female, living in rural areas and having a HT diagnosis significantly increase adherence odds. Not taking medicines regularly strongly decreases adherence likelihood (OR = 0.19), salt-related knowledge is not a significant predictor, but smartphone use was associated with slightly lower adherence (OR = 0.87) (Figure 4).

## 4 | DISCUSSION

This large, nationwide cross-sectional study, part of the opportunistic screening, provides the most comprehensive insight to date into the current state of adherence to antihypertensive medicines in Croatia. In this large group, we were able to evaluate medicine-taking behaviour across a diverse sample using the validated MARS-5 scale. The key finding that 31.8% of patients were classified as nonadherent is consistent with global estimates and highlights an urgent need to enhance long-term treatment strategies and patient engagement in Croatia. Compared to other European nations, Croatia's adherence and control rates appear mid-range. In a Romanian urban primary care setting, ~70% of patients achieved high adherence levels.[12] Greece and Bulgaria report poorer adherence, particularly in younger populations and those with lower health literacy.[13,14] Northern and Western European countries typically show better adherence due to stronger health system integration, shorter prescription intervals and better follow-up mechanisms.[15] Our study confirms that suboptimal adherence is a critical obstacle to achieving therapeutic BP control. Treated controlled hypertensive patients exhibited significantly higher self-reported adherence across all five MARS domains compared to those with uncontrolled HT. MARS distinguishes between various nonadherent behaviours, such as forgetfulness, skipping doses or altering treatment based on personal judgement, making it more informative than binary yes/no questions. Its use in clinical and research settings has shown that it is simple to administer, cost-effective and capable of capturing adherence patterns that are both behaviourally and attitudinally driven.[16,17] The high internal consistency of the MARS-5 in our study, and its criterion validity, as evidenced by significantly better BP values among adherent participants reinforce its utility in assessing real-world adherence in European primary care settings.[18] Our findings align with previous Croatian studies reporting adherence rates on chronic antihypertensive medicines consistent with general trends in developed countries. Another study in Croatia's capital Zagreb showed that long-term adherence among elderly patients on chronic antihypertensive medicines averaged around 50%.[19] Furthermore, a study comparing fixed-dose *vs*. free-drug combinations reported BP control in only 24.8% of participants overall, yet significantly better outcomes among those receiving fixed-dose regimens—highlighting

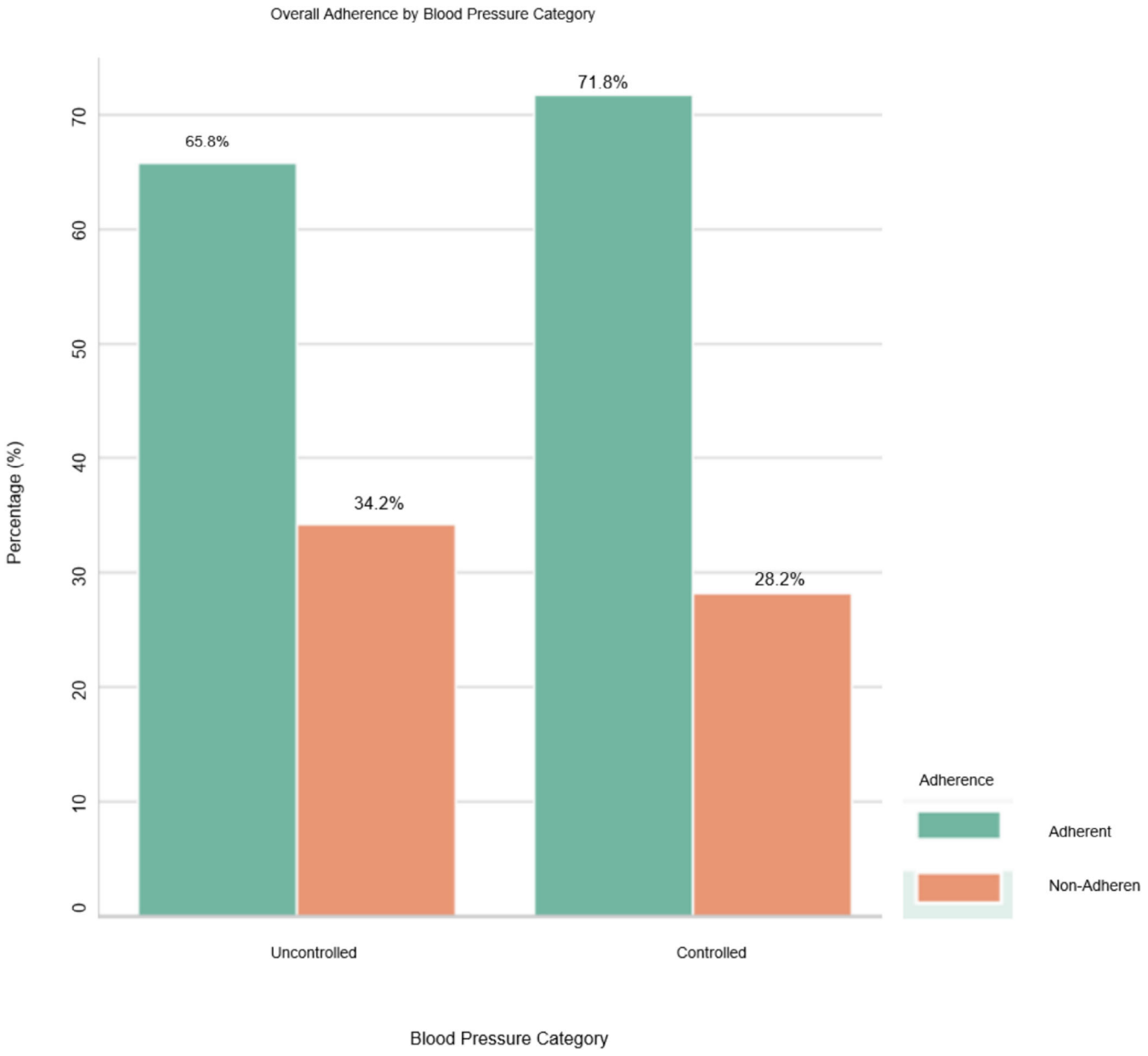


**FIGURE 2** Adherence in controlled and uncontrolled hypertensive patients. Adherent was defined as scores 23–25 and nonadherent as scores 5–22 on MARS questionnaire; controlled BP <140/90 mmHg, uncontrolled BP ≥140/90 mmHg $^{*}\chi^2$ test; uncontrolled $p = 0.0005$; controlled $p = 0.0001$.

the importance of simplified treatment protocols in enhancing adherence.[20] Importantly, by using a validated instrument in a large national sample, we offer more granular insights into behaviour-based adherence determinants. In contrast to prior studies that used simplistic or binary adherence measures, the MARS allowed us to differentiate between various types of nonadherences—forgetfulness, unintentional skipping or intentional dose adjustment. Notably, our data suggest that intentional behaviours such as changing or skipping doses were more common than complete discontinuation. This is consistent with other findings and indicates that even with partial adherence to treatment, patients may still need targeted support.[21] Sex, age and residential setting emerged as significant predictors of adherence. Female sex was associated with higher odds of adherence (OR = 1.29), echoing findings from both the PURE study and the European HEARTS adherence registry.[22,23] This is an important consideration in personalized care and higher adherence may partially explain sex-based differences in BP control at older ages.[24]

Demographic and geographic disparities further complicate adherence behaviour in Croatia. Urban *vs.* rural comparisons offer mixed results: While initial BP control rates may be similar, long-term control tends to be slightly better in urban areas, likely due to better healthcare infrastructure and access to follow-up services.[25] It was reported that in more remote areas, including islands and hinterland rural communities, geographical isolation, reduced access to public

**TABLE 1** Descriptive analysis of MARS questionnaire regarding adherence and BP control.

| | Adherence* | | | BP control** | | |
|---|---|---|---|---|---|---|
| | Adherent $N = 4179$ Mean (SD) | Nonadherent $N = 1925$ Mean (SD) | *p* | Controlled BP $N = 1965$ Mean (SD) | Uncontrolled BP $N = 1876$ Mean (SD) | *p* |
| Taking less than prescribed | 4.97 ± 0.19 | 3.6 ± 1.31 | <0.0001 | 4.97 ± 0.19 | 3.6 ± 1.31 | <0.0001 |
| Stop taking drugs for a period of time | 4.98 ± 0.17 | 4.05 ± 0.99 | <0.0001 | 4.98 ± 0.17 | 4.05 ± 0.99 | <0.0001 |
| Miss a dose | 4.82 ± 0.39 | 3.63 ± 0–83 | <0.0001 | 4.82 ± 0.39 | 3.63 ± 0.83 | <0.0001 |
| Adjust the dose by yourself | 4.97 ± 0.22 | 4.25 ± 0.96 | <0.0001 | 4.97 ± 0.22 | 4.25 ± 0.96 | 0.0002 |
| Forget to take the prescribed drugs | 4.68 ± 0.51 | 3.65 ± 0.80 | <0.0001 | 4.68 ± 0.51 | 3.65 ± 0.80 | <0.0001 |

*Adherent was defined as scores 23–25 and nonadherent as scores 5–22 on MARS questionnaire; scores: 1, Never; 2, Seldom; 3, Sometimes; 4, Often; 5, Always; higher scores indicate better adherence.
**Controlled BP <140/90 mmHg, uncontrolled BP ≥140/90 mmHg.

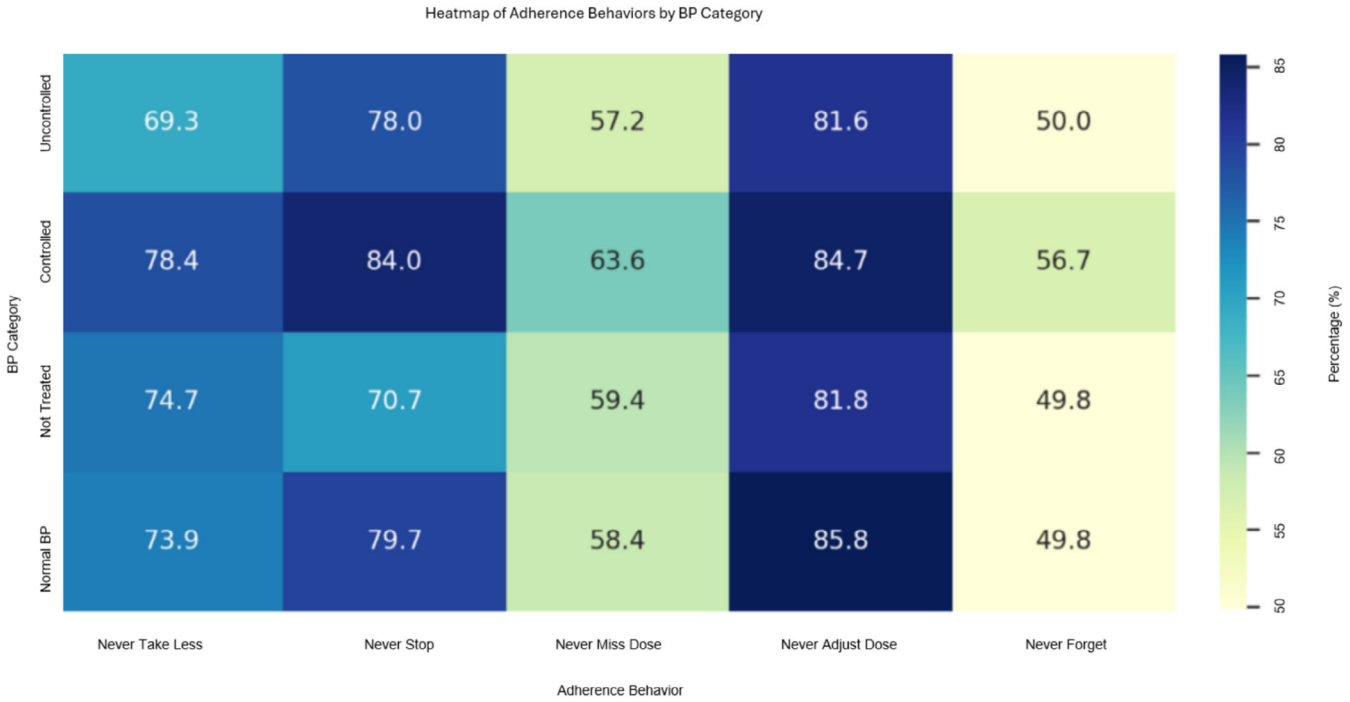


**FIGURE 3** Heat map of adherence by blood pressure category. This heat map provides a clear summary of adherence behaviours across all BP categories: controlled patients (second row from the top) show the best adherence behaviours across nearly all MARS items. Out of them, 78.4% 'always' take medication as prescribed while in uncontrolled and not treated group only 69.3% and 74.7%, respectively, say 'always' ($p < 0.0001$ for controlled *vs.* uncontrolled). Uncontrolled patients have visibly lower adherence in key areas like 'Never Miss Dose' and 'never forget'. They were also less likely to stop medication: 84% 'never' compared to uncontrolled: 78% ($p < 0.0001$) showing that intermittent stopping is linked with poor BP control. Again, controlled participants show better behaviour regarding 'missing dose' with 63.6% 'always' take doses *vs.* 57.2% for uncontrolled. The highest self-adjustment was in the uncontrolled group (17.8% adjust 'sometimes' or more) compared to 16.4% uncontrolled participants. Forgetfulness in taking medication was most common in uncontrolled (only 50% 'always' take it), compared to 56.7% in controlled ($p < 0.001$). Participants with uncontrolled hypertension had more frequent nonadherence behaviours (forgetting, stopping and underdosing).

pharmacies and transportation limitations may act as additional barriers to treatment continuity and adherence [6, 8 13]. Interestingly, we found that living in a rural setting was associated with better adherence (OR = 1.21), which appears counterintuitive given the common assumption that urban residents benefit from better healthcare access. However, this could suggest that patients in smaller or rural communities may have stronger primary care relationships (including commune pharmacists) and fewer barriers to follow-up once diagnosed or it may reflect that those who are aware of having HT are more highly motivated or supported.[26,27] Age also played a

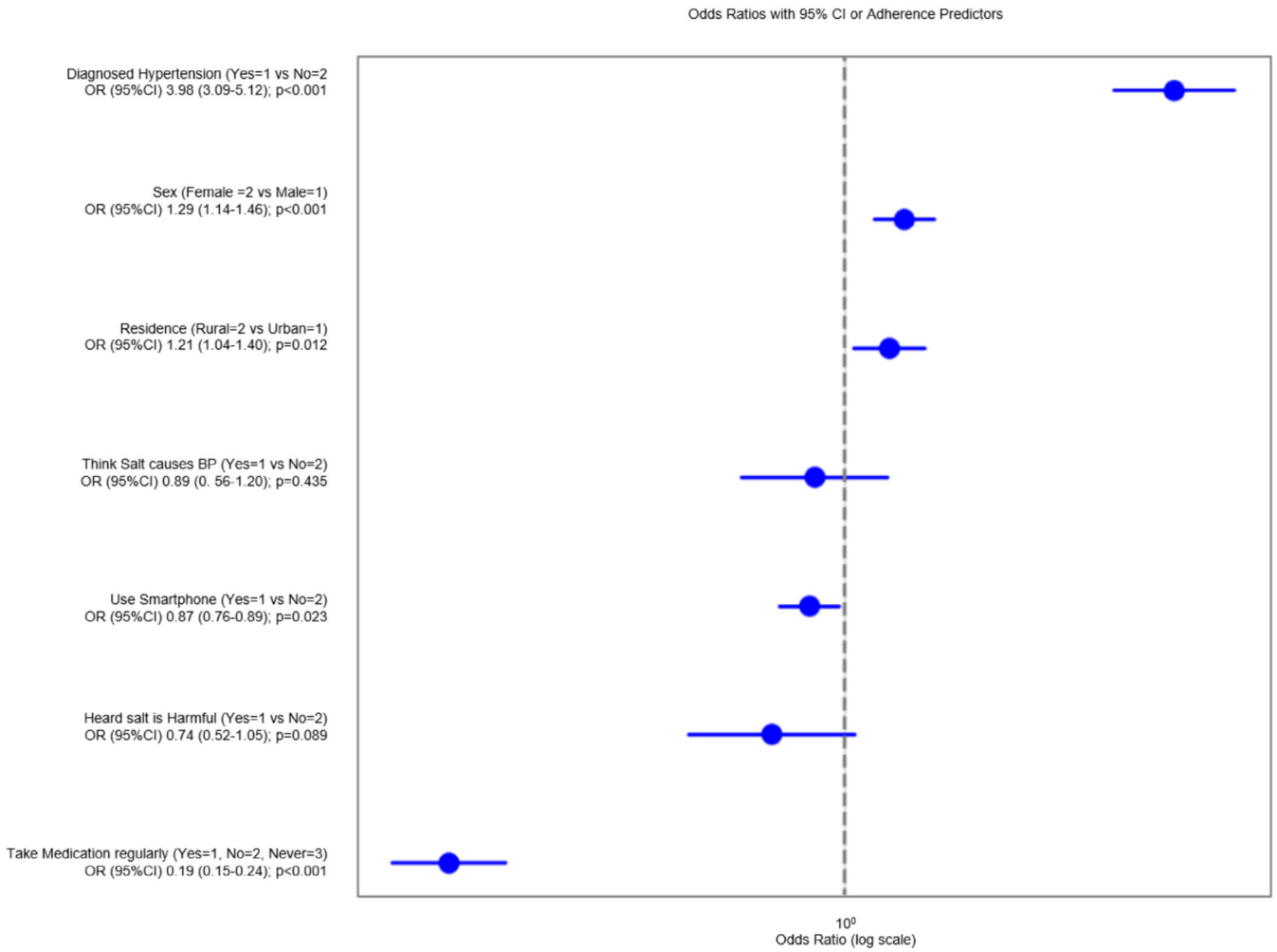


**FIGURE 4** Independent associations between participants' characteristics and adherence. Univariate binominal logistic regression: OR >1 = increased odds of adherence; OR <1 = decreased odds of adherence.

notable role. Younger individuals (aged 20–59) were significantly more likely to be nonadherent, a pattern observed across Europe and globally.[6,28] This may reflect differences in health beliefs, a perceived lower risk of complications, or competing life priorities. The heat map analysis of MARS behaviours provides additional depth by highlighting specific domains where nonadherent patients diverge. Missed doses and forgetfulness were most often reported, especially in untreated or uncontrolled HT cases. This is in line with previous findings indicating that forgetfulness is the most frequent self-reported reason for nonadherence in NCD populations.[9] The association between irregular medicines intake and poor BP control was especially noticeable with only 69.3% of uncontrolled hypertensive participants reported 'always' taking medicines as prescribed. This reinforces the growing body of evidence that daily implementation, rather than mere prescription filling, is the major barrier to long-term therapeutic success.[9] Interestingly, self-adjustment of medicines, one of the lesser studied forms of intentional nonadherence, was most frequent among uncontrolled patients. While this behaviour may stem from attempts at autonomy or avoiding side effects, it reflects poor communication and a lack of trust in the prescribed regimen. Addressing this requires improved patient education and shared decision-making during consultations.[22,23] Our findings have major implications for public health and clinical practice. First, screening for nonadherence should become a routine part of HT management, particularly among patients with suboptimal BP control, those with apparent resistant HT and those on combination therapy. Tools like MARS-5 are not only validated but also easily implemented in clinical settings, allowing for early identification and targeted interventions. The use of MARS or similar validated tools is still inconsistent across Europe, hindering direct comparison. However, ESH has emphasized the importance of routinely assessing adherence as part of clinical risk management.[10] Second, fixed-dose combinations should be more widely promoted. Our data support previous Croatian studies showing better BP control among users of fixed-dose combinations.[20,29,30] Simplified treatment schedules reduce the burden on memory and improve long-term persistence, particularly in populations with polypharmacy.[21] Third, smartphone use was paradoxically associated with slightly lower adherence (OR = 0.87), a surprising finding in the context of *mHealth*

enthusiasm.[31] While digital interventions have shown promise, this may indicate that ownership does not equate to utilization. Passive information consumption or smartphone distractions can hinder routine adherence unless supported by structured, interactive health programmes.[32] Fourth, adherence-promoting interventions should be personalized based on the demographic profile. In our population, younger, urban-dwelling men represent a key high-risk group. Targeted behavioural interventions, possibly incorporating technology and motivational interviewing, may help address their lower perceived vulnerability and increase routine adherence.[33] Engagement of community pharmacists in this study, and overall activities of the CHL confirmed previous evidence that this group of healthcare professionals could significantly contribute to BP control, among many aspects, also by increasing adherence.[34–37]

## 5 | STRENGTHS AND LIMITATIONS

The strengths of this study include its large, nationally representative sample, real-world setting (community pharmacies) and the use of a validated adherence instrument. The inclusion of detailed behavioural data offers practical insights that go beyond binary classifications of adherence. By inviting all eligible adults and reporting the geographic and demographic composition of participants, we minimized potential selection/healthy-volunteer bias (adults who do not visit pharmacies). Data on demographics, comorbidities and adherence were self-reported using the nonjudgmental MARS-5, which reduces but does not eliminate recall and social-desirability bias. BP was measured in a standardized way (5-minute rest, correct cuff and three automated readings; mean of the last two), yet single-visit screening is susceptible to white-coat effects and environmental variation; accordingly, HT prevalence is interpreted as screening-based. Because participants are clustered within pharmacies, we account for within-site correlation in analyses and report intra-cluster correlation where relevant. We prespecified adjustment for age, sex, comorbidities and lifestyle factors to reduce confounding. However, several limitations should be noted. First, self-reported measures inherently carry the risk of social-desirability bias, although the anonymous and nonjudgmental phrasing of the MARS mitigates this to some extent. Second, the cross-sectional nature of the opportunistic screening study limits causal inference. Third, the lack of electronic health records and prescription refill data precluded objective verification of adherence. We are aware that the most common method to assess temporal stability in questionnaires is to administer the questionnaire to the same group of people at two different points in time. However, given the design of our research, which was part of a public health campaign, this was impossible. Finally, while urban and rural areas were both represented, regional differences in prescribing practices or healthcare access may not be fully captured. Our findings suggest several avenues for future research. Longitudinal studies are needed to track adherence and BP outcomes over time. Additionally, qualitative studies may uncover the nuanced motivations behind intentional nonadherence, especially among younger adults. From a policy perspective, embedding routine adherence screening into primary care via community pharmacies, electronic medical systems or *mHealth* tools could help bridge the gap between prescription and actual therapeutic impact. The development of low-cost, scalable interventions such as texts reminders, pill packaging solutions or pharmacist-led adherence counselling could be particularly impactful in middle-income countries like Croatia.

## 6 | CONCLUSION

This study highlights that nearly one third of hypertensive patients in Croatia do not adhere to prescribed medication regimens, significantly compromising BP control. Using a validated tool like MARS-5 reveals behavioural nuances that traditional methods miss. Addressing this issue will require a multilevel approach that includes routine adherence assessment, patient-centred education, simplified pharmacotherapy and behavioural interventions tailored to high-risk groups. Highly motivated community pharmacists in our study confirmed that these healthcare workers should be more engaged in management of hypertensive and other NCDs patients. In doing so, Croatia and other European nations facing similar challenges could significantly advance toward better cardiovascular outcomes and reduced burden of disease.

### AUTHORS CONTRIBUTIONS

BJ, AS and VBL conceptualized the study. TŠ, SVT, OVŠ, MMG, VBL and BJ conducted data analysis. VBL and BJ drafted the manuscript. All authors contributed to data interpretation and critically revised the final manuscript.

### ACKNOWLEDGEMENTS

We thank the pharmacists and all other members of the Croatian Hypertension League, coworkers involved in the May Measurement Month 2023 campaign across Croatia for their support and collaboration. Our special thanks go to the d8solutions company, a digital partner of the Croatian Hypertension League, particularly to Mrs. Katarina Grgurić for assistance and help. We are thankful to the *Salvus* company, which provided us with Microlife devices for the study. Open access publishing facilitated by Sveuciliste u Zagrebu, as part of the Wiley - National and University Library in Zagreb Consortium Croatian Academic and Research Libraries Consortium agreement.

### CONFICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

### DATA AVAILABILITY STATEMENT

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

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**How to cite this article:** Lang VB, Soldo A, Škopić OV, et al. Nonadherence and uncontrolled arterial hypertension in Croatia—Insights from the *May Measurement Month 2023* campaign and *Hunting the silent killer* programme. *Br J Clin Pharmacol*. 2025;1-10. doi:10.1002/bcp.70314