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Bridging the pulse: Exploring inequalities in diabetes and hypertension medication prescriptions in Spain's immigrant and native communities

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ABSTRACT

Migrants often face barriers in accessing high quality healthcare, leading to unequal treatment. This research investigates the disparities in medication utilization for cardiovascular risk factors between immigrant and native-born populations in Spain. The study specifically examines differences in drug prescriptions for managing diabetes and hypertension, two key contributors to cardiovascular disease. We analyze administrative healthcare records to examine the probability of patients receiving prescriptions for antidiabetic and antihypertensive medications. Additionally, we assess the likelihood of patients undergoing tests to measure glycated hemoglobin levels and blood pressure, two crucial indicators for monitoring diabetes and hypertension management.The analysis is stratified across different levels of medical needs, by also controlling for individual socioeconomic status, physician diagnoses, biometric data and primary care centers fixed effects. The findings reveal that all immigrant groups have lower probabilities of being prescribed medications for diabetes and hypertension and this is especially true for people with higher levels of healthcare needs. These findings underscore the importance of addressing healthcare disparities to achieve more equitable outcomes for immigrant communities.

1. Introduction

In recent decades, two significant global trends have intersected to create pressing challenges for healthcare systems worldwide: the increasing prevalence of cardiovascular diseases (CVDs) and the rise in international migration. CVDs remain the leading cause of morbidity and mortality globally, with risk factors such as diabetes and hypertension playing pivotal roles (Vaduganathan et al., 2022). Europe has witnessed a substantial surge in immigration, a trend projected to persist due to factors such as economic disparities, climate change, and geopolitical conflicts (King and Okólski, 2019; OECD, 2016). Access to healthcare is a critical determinant of health outcomes, particularly for immigrant populations. Despite ongoing efforts to promote equity, significant disparities in healthcare access between migrants and native-born populations persist across various settings (Solé-Auró et al., 2012). These disparities are especially pronounced in the management of chronic conditions like CVDs and their associated risk factors (Jang et al., 2023).

Research shows that immigrants often receive suboptimal management for diabetes (Agyemang et al., 2021; Marchesini et al., 2014; Seghieri et al., 2019) and hypertension (Fontil et al., 2022; Eastwood et al., 2022) compared to native populations, with less healthcare access, less satisfaction and more health problems (Lebano et al., 2020).

This study investigates healthcare disparities between immigrants and native-born individuals in Spain, using individual electronic healthcare data to analyze the treatment of two major cardiovascular disease risk factors (CVDRFs): diabetes and hypertension. Specifically, we examine differences in medication prescriptions and diagnostic testing for these conditions across the population groups defined by the area or origin. We define disparities as significant variations in the likelihood of receiving appropriate care – including prescribed medications and routine health checks – that cannot be attributed to differences in clinical needs or socioeconomic status. Using administrative electronic health records from Spain (BDCAP), we conduct a detailed analysis of the treatment of diabetes and hypertension among various immigrant groups in comparison to the native population. This study examines differences in healthcare access for these chronic conditions by stratifying the analysis across different levels of needs. We define the

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levels of needs by combining information about individual-level demographics, current and past diagnoses and drug prescriptions. When available, we further include biomarker measurements such as glycated haemoglobyn and systolic and diastolic blood pressure. By focusing on specific subpopulations defined by levels of health needs, we also control for the individual socioeconomic status and for primary care centers identifiers.

Our findings reveal that immigrant groups (i.e., individuals born in Eastern European, African, Latin American, Asian, and other European countries) are less likely to receive medications for cardiovascular risk factors compared to native-born individuals, even after controlling for treatment needs. These disparities in access to healthcare and the use of medications highlight the urgent need to address barriers that can limit the ability of immigrants to obtain necessary medical care for managing and preventing cardiovascular diseases. The disparity is more pronounced in large towns, where a significant percentage of migrants is also concentrated. We also observe greater disparities among older groups of immigrants.

Although previous studies have explored healthcare inequalities related to migration in Spain (Antón and de Bustillo, 2010; Hernández-Quevedo and Jiménez-Rubio, 2009; Jiménez-Rubio and Hernández-Quevedo, 2011), particularly highlighting barriers to accessing hospital, specialist and emergency services, there is still a significant gap in understanding the specific disparities in the management of cardiovascular risk factors among immigrants. Moreover, much of the existing research on the patterns of pharmaceutical consumption does not adequately control for individual health needs (Gimeno-Feliu et al., 2016), potentially misinterpreting lower drug use as a sign of better overall health, rather than as a reflection of inadequate care.

Several interconnected factors contribute to these inequalities. Language and communication barriers have been linked to increased reliance on emergency care, while experiences of discrimination further exacerbate the problem (Lillie-Blanton and Hoffman, 2005; Clarke and Isphording, 2017; Lebano et al., 2020; Pandey et al., 2021). Additionally, cultural differences in health beliefs and practices can affect medication adherence, and socioeconomic factors often lead to residence in areas with limited healthcare access. Legal status, restrictions on health insurance coverage, and systemic barriers within healthcare systems further compound these challenges (Derose et al., 2007; Sanchez et al., 2017).

Diabetes is a chronic endocrine disorder that affects blood sugar levels and is a significant risk factor for CVD. Migrants in Europe exhibit a higher prevalence of diabetes and develop the disease at younger ages compared to host European populations, by also receiving suboptimal diabetes management (Agyemang et al., 2021). Numerous other studies highlight evidence of undertreatment with antidiabetic medications among immigrant and minority populations in high-income countries. In Italy, immigrants face a heightened risk of diabetes compared to native Italians, encountering reduced likelihood of glycaemic control and receiving suboptimal treatment (Marchesini et al., 2014; Seghieri et al., 2019). In the UK, South Asian and Black communities demonstrate slower transitions to non-insulin combination therapy and insulin therapy following diagnosis, coupled with increased therapeutic inertia (Mathur et al., 2020). Although the settings may diverge, racial and ethnic disparities in the initiation of newer diabetes medications are also documented in the United States (Marcondes et al., 2021).

Concerning hypertension, another major CVD risk factor, South Asian and African-Caribbean individuals in the UK are more likely to receive treatment for high BP and are prescribed more anti-hypertensive agents, yet they achieve lower BP control compared to European individuals (Fontil et al., 2022). In another UK-based study, ethnicity does not appear to influence the initiation of antihypertensive treatment, although individuals of African or African Caribbean descent show lower rates of blood pressure control after treatment initiation, which could be related to a reduced adherence to regular medication regimens (Eastwood et al., 2022). In addition, Guadamuz et al. (2020) finds that undocumented and documented Hispanic/Latino immigrants in the US are less likely to receive treatment for high cholesterol, hypertension, and diabetes compared to naturalized citizens, largely due to limited access to healthcare.

Our research makes several critical and novel contributions to the existing body of knowledge. First, we present the most comprehensive examination to date of cardiovascular risk factor treatment among diverse immigrant groups in Spain with different levels of health needs. By focusing specifically on diabetes and hypertension, two pivotal indicators of chronic disease management, we move beyond previous broad analyses to study (i) the initiation of pharmaceutical treatment, (ii) the utilization of medications among patients with higher needs, (iii) the access to diagnostic tests.

Recent studies highlight significant cardiovascular disease (CVD) disparities among immigrant populations in Europe. Rodriguez-Alvarez et al. (2020) identified a higher prevalence of cardiovascular disease (CVD) risk factors among Eastern European immigrants in Spain, while African immigrants exhibited lower risks. Cainzos-Achirica et al. (2019) reported high prevalence of CVD risk factors and established CVD among South Asian and sub-Saharan African immigrants in Catalonia, Spain. Given these findings, our study is both timely and critical in urging authorities and policymakers to prioritize addressing the healthcare needs of these ethnic minority groups.

This study also situates findings within a broader context of global evidence on migrant health. Studies have shown that immigrants initially exhibit better health outcomes than native populations in countries like UK (Giuntella et al., 2019), the USA (Palarino, 2021) Canada (Vang et al., 2017), and Australia (Huang et al., 2023). Regarding Europe, Moullan and Jusot (2014) identify a North–South gradient in immigrants' health, where immigrants appear to report a better health status than native-born individuals in Italy and in Spain, and a worse one in France and Belgium. These findings have been confirmed by Farré (2016) for the Spanish setting and Lorant et al. (2008) for the Belgian one. Even in contexts where immigrants often initially exhibit better health than native-born populations ("healthy immigrant effect", HIE), such advantage may erode over time due to various factors, including physically demanding work and unfavorable living conditions (Giuntella, 2012; Alacevich and Nicodemo, 2023; Giuntella et al., 2019). These factors could lead to a reversal of the health advantage initially observed among immigrants compared to native-born individuals (Bousmah et al., 2019). This dynamic might help explain why in some contexts, immigrants facing declining health may choose to return to their home countries, phenomenon known as the "salmon bias effect". This tendency can result in immigrants exhibiting a mortality advantage and different patterns of healthcare utilization compared to native-born individuals (Di Napoli et al., 2021; Dunlavy et al., 2022).

In general, our findings align with recent reviews emphasizing persistent inequalities between migrants and non-migrants in access to healthcare services (Lebano et al., 2020). In particular, our results are mostly in line with recent works on migration- and ethnicity-related inequalities in medical care access for diabetes (Agyemang et al., 2021; Mathur et al., 2020; Seghieri et al., 2019; Marchesini et al., 2014), hypertension (Fontil et al., 2022; Eastwood et al., 2022) and other CVDRFs (Guadamuz et al., 2020).

The paper is structured as follows. In Section 2 we present the data and setting. Section 3 delves into the methodology employed, while Section 4 shows the findings. Finally, Section 5 presents the discussion and Section 6 the conclusion of the paper.

2. Data and setting

The Spanish National Health System (Sistema Nacional de Salud — SNS) was established through the *Ley General de Sanidad* (the "Health General Law") in 1986. It is financed out of general taxation and its cost is included in the general budgets of Autonomous Communities

Table 1
Descriptive statistics across native-born and immigrant groups in the study sample.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

	All sample		At least one health probl.		At least one prescr.	
	Native-born	Immigrants	Native-born	Immigrants	Native-born	Immigrants
Demographics						
% of women	50.58	51.69	51.35	53.43	53.60	58.26
Average age	55.57	51.32	55.82	51.43	57.14	52.17
CVD Risk factors and health needs						
% diagnosed with diabetes	8.88	6.23	9.51	6.93	11.69	9.16
% prescribed with antidiabetic drugs	8.44	5.31	9.02	5.91	11.59	9.14
% diagnosed with hypertension	34.00	22.59	36.30	25.10	43.35	32.98
% prescribed with antihypertensives	26.08	14.02	27.79	15.58	35.80	24.10
% smoking in 2017	14.17	8.90	14.54	9.22	14.77	9.59
% smokers in 2018	14.54	9.22	14.27	8.99	15.18	9.97
Total other comorbidities (no diabetes)	7.32	6.69	7.85	7.46	8.83	9.14
Total other comorbidities (no HBP)	7.46	6.84	7.99	7.63	9.00	9.35
Income Groups						
≥ 100,000 €	1.27	0.75	1.05	0.54	0.85	0.41
18,000-99,999 €	39.14	12.11	39.15	12.27	37.10	13.12
≤ 18,000	54.55	76.81	55.06	77.52	56.99	76.32
Very low income	4.45	8.65	4.55	8.90	4.96	9.68
Unknown income	0.59	1.67	0.19	0.76	0.10	0.48
Occupational Status						
Active	51.04	48.89	50.88	50.95	46.48	57.36
Retired	26.50	7.92	27.68	8.44	32.76	11.00
Unemployed	8.00	15.21	8.05	15.70	8.16	14.37
Inactive	11.84	20.86	11.23	19.48	11.55	14.11
Other status	2.61	. 7.11	2.16	5.43	1.07	3.15
Individuals	858,557	127,757	801,227	114,571	625,577	74,301

Column (1) and (2) report means and proportions for the whole sample of the individuals aged 39–75 registered in the PCC. Column (3) and (4) report means and proportions for the sample of individuals aged 39–75 with at least one active health problem in 2018. Column (5) and (6) report means and proportions for the sample of individuals aged 39–75 with at least one medication prescribed in 2018. The categories for the income groups and for the occupational status are mutually exclusive.

(ACs). In Spain, healthcare provision is managed by ACs, dividing the territories into health areas (AS) and basic health zones (ZBS) – the smaller administrative units for healthcare delivery. Within a ZBS, multiple primary care centers (PCC) are typically available, and residents are registered under the PCC within their ZBS of residence. After registration, patients are not permitted to freely select their General Practitioner (GP) within the PCC.

Our study utilizes data from the *Base de Datos Clínicos de Atención Primaria* (BDCAP),[1] an administrative dataset on the use of primary care. The BDCAP comprises a random subsample of health records representing approximately one-tenth of the Spanish population annually. The dataset covers 11 regions for 2017 and 2018, focusing on individuals aged 39 to 75 without prior treatment. Our final sample includes 986,314 individuals, 858,557 native-born individuals and 127,757 immigrants (12.95%), respectively. Immigrants are defined by country of birth; individuals are therefore grouped into the following six categories: native-born Spaniards, East Europeans, Africans, Latin Americans, Others Europeans and Asians. As per Royal Decree-Law 7/2018,[2] Spain's healthcare system provides free access to all residents, including immigrants (regular immigrants, asylum seekers, refugees or irregular immigrants).[3]

Health records in the BDCAP data include diagnoses, staff interactions, and prescriptions. Drug prescriptions are documented using the WHO Anatomical Therapeutic Chemical (ATC) Classification System. We analyze prescriptions using the ATC2 classification, focusing on antidiabetic medications (ATC-2 code "A10") and antihypertensive drugs (codes "C02", "C03", "C04", "C07", "C08", "C09"). To objectively assess treatment needs, we incorporate biomarkers such as glycated hemoglobin, blood pressure readings, and physician-reported tobacco consumption.

Concerning diabetes, we follow the American Diabetes Association guidelines to group individuals according to their glycated hemoglobin value: normal-level glycated hemoglobin, pre-diabetes, and diabetes (see Table A.1 in the Appendix). Following Gijon-Conde et al. (2018), individuals are grouped into four categories according to their systolic and diastolic blood pressure parameters: normal blood pressure, elevated blood pressure, stage-1 hypertension and stage-2 hypertension (see Table A.2 in the Appendix).

The income variable is derived from co-payment brackets, categorized into five groups,[4] with rates varying based on employment status and income, generally keeping out-of-pocket costs low for most patients.

The map in Fig. 1 (Appendix) shows the distribution of immigrants across Spain's autonomous communities. Madrid has the largest share (40.08%), followed by the Balearic Islands (11.80%) and the Canary Islands (11.19%).

Table 1 shows descriptive statistics comparing native-born and immigrant groups across three samples: the full sample, individuals with at least one health problem, and those with at least one prescribed

[1] Available through the Spanish Ministry of Health: https://www.sanidad.gob.es/estadEstudios/estadisticas/estadisticas/estMinisterio/SIAP/home.htm

[2] https://www.boe.es/buscar/doc.php?id=BOE-A-2018-10752

[3] Prior to 2018, particularly from 2012 to 2018, Royal Decree 16/2012 stripped undocumented immigrants of their right to access healthcare. Jiménez-Rubio and Vall Castelló (2020) show that these restrictions led to reduced planned care and declining perceptions of available healthcare services. Regional variations in implementation produced different outcomes, with stricter enforcement showing stronger effects. Within three years of implementation, evidence suggested deteriorating self-assessed health. However, most autonomous communities bypassed the decree through regional regulations that relaxed access, effectively mitigating the reform's impact over time (Jiménez-Rubio and Vall Castelló, 2020).

[4] The Spanish National Health System employs a tiered co-payment scheme for medications https://www.sanidad.gob.es/estadEstudios/estadisticas/sisInfSanSNS/pdf/aportacionRecetaSNS.pdf

medication. The sample includes 858,557 Spaniards and 127,757 immigrants. In 2018, 8.04% (79,281 individuals) had at least one antidiabetic prescription, and 24.52% (241,862 individuals) had at least one antihypertensive prescription. A subsample also includes data on blood pressure and glycated hemoglobin as CVD risk factor biomarkers. Immigrants are younger on average (51.32 years vs. 55.57 years for natives), and women are slightly more represented among immigrants, especially in the prescribed medication subsample (58.26% vs. 53.60%). Native-born individuals show higher rates of diabetes (9.51% vs. 6.93%) and hypertension (36.30% vs. 25.10%) compared to immigrants, along with greater use of antidiabetic (11.59% vs. 9.14%) and antihypertensive medications (35.80% vs. 24.10%). Smoking is also more prevalent among natives. Immigrants are disproportionately in the lowest income bracket (76.81% vs. 54.55%) and more likely to be unemployed or inactive. Despite socioeconomic disadvantages, immigrants face barriers to healthcare, leading to lower diagnosis and treatment rates than native-born individuals.

3. Methodology

The empirical analysis considers four subsamples. The first subsample focuses on "previously untreated" individuals who, in 2017, were either undiagnosed or had biomarker values below clinical thresholds and were not receiving treatment for diabetes or hypertension. The second subsample, drawn from the "previously untreated" group, comprises individuals who exhibited at least one cardiovascular disease (CVD) risk factor in 2017. For the diabetes analysis, CVD risk factors included being overweight, dyslipidemia, smoking, or hypertension. For the hypertension analysis, risk factors included being overweight, dyslipidemia, smoking, or diabetes.

The third subsample consists of individuals with recorded glycated hemoglobin and blood pressure measurements in 2017. To control for antidiabetic and antihypertensive medication needs, we categorize blood pressure as normal, elevated, stage-1 hypertension, or stage-2 hypertension, and glycated hemoglobin as normal, pre-diabetes, or diabetes. The fourth subsample, termed "diagnosed", includes individuals who either received a physician's diagnosis of diabetes or hypertension, or had glycated hemoglobin and blood pressure values exceeding clinical thresholds in 2017.

This stratified sampling approach enables estimation of regression coefficients across varying levels of health needs, capturing need-specific associations between medication access and supply–side factors proxied by the primary care centers vector. For individuals with glycaemic control or blood pressure checks, we further refine health needs assessment using biomarker data.[5]

Our empirical strategy is summarized in the equations below. Eq. (1) predicts the likelihood of receiving at least one pharmaceutical prescription whether it is for diabetes or for high blood pressure.

$$Prescr_i = \alpha^N + \beta^N \cdot Imm_i + \gamma^N \cdot SES_i + \theta^N \cdot X_i + \psi^N \cdot Totmultimorbities_i + \lambda^N \cdot C_i + \epsilon_i^N \quad (1)$$

where $Prescr_i^N$ refers to the probability of receiving a prescription for diabetes or high blood pressure for individual i across the following subsamples stratified according to health needs: (i) previously undiagnosed individuals, (ii) previously undiagnosed individuals with other CVD risk factors,[6] and (iii) diagnosed individuals. Imm_i is the migration status vector composed of six categories: Spaniards, East Europeans, Africans, Latin Americans, Others Europeans and Asians. SES_i is the vector for the socioeconomic status (including the income group and the occupation status), X_i is the vector of demographic characteristics (age and sex). $Totmultimorbities_i$ is the total number of comorbidities, excluding those related to diabetes or blood pressure, and C_i refers to the vector of fixed effects for primary care centers.

Eq. (2) predicts the probability of receiving a prescription in the subsample of individuals who had a glycaemic control or a blood pressure check by also controlling for the glycated hemoglobin and blood pressure measurements.

$$Prescr_i = \alpha^N + \beta^N \cdot Imm_i + \gamma^N \cdot SES_i + \theta^N \cdot X_i + \delta^N \cdot Biomarker_i + \psi^N \cdot Totmultimorbities_i + \lambda^N \cdot C_i + \epsilon_i^N \quad (2)$$

$Prescr_i$ refers to the probability of receiving a prescription for diabetes or high blood pressure for individual i belonging to the "checked" group. Imm_i is the migration status vector composed of six categories: Spaniards, East Europeans, Africans, Latin Americans, Others Europeans and Asians. SES_i is the vector for the socioeconomic status (including the income group and the occupation status), X_i is the vector of demographic characteristics (age and sex). $Totmultimorbities_i$ is the total number of comorbidities excluding those related to diabetes or blood pressure. $Biomarker_i$ is the vector of biomarker values in categories (glycated hemoglobin and systolic and diastolic blood pressure). C_i refers to the vector of fixed effects for primary care centers.

Furthermore, to study the selection into the subsample with biomarkers checked, we proceed to estimate Eq. (3) where the dependent variable is represented as a binary outcome indicating whether glycated hemoglobin and blood pressure were assessed in 2018.

$$Check_i = \alpha^N + \beta^N \cdot Imm_i + \gamma^N \cdot SES_i + \theta^N \cdot X_i + \psi^N \cdot Totmultimorbities_i + \lambda^N \cdot C_i + \epsilon_i^N \quad (3)$$

where $Check_i$ refers to the probability of having a glycaemic or a blood pressure control, Imm_i is the migration status vector (Spaniards, East Europeans, Africans, Latin Americans, Others Europeans and Asians), SES_i is the vector for the socioeconomic status (including the income group and the occupation status), X_i is the vector of demographic characteristics (age and sex), $Totmultimorbities_i$ is total number of comorbidities excluded those related to diabetes or blood pressure, and C_i refers to primary care center (PCC) fixed effects vector. All estimates are obtained by employing linear probability models (LPM) with absorbed PCC fixed effects and robust standard errors clustered at the PCC level.

4. Results

4.1. Main results

Results on the probability of receiving diabetes and high blood pressure prescriptions are shown in Tables 2 and 3. Estimates come from linear probability models with clustered standard errors at the PCC level and PCC fixed effects. Immigrant groups are compared to native-born individuals as the baseline. Column 1 includes individuals undiagnosed in 2017, Column 2 restricts this to those with other CVDRFs, Column 3 focuses on individuals with biomarker data (glycated hemoglobin and blood pressure), and Column 4 covers the already diagnosed subsample.

Table 2 highlights significant ethnic differences in diabetes treatment. In 2017, undiagnosed individuals from Asia were 1.2 percentage points (p.p.) more likely to get medication for diabetes. In contrast, individuals from Other Europe had a lower likelihood of being treated. Among undiagnosed individuals with CVDRF, Asians and Africans showed higher probabilities of 1.4 p.p. and 0.6 p.p., respectively, while those from Other Europe had a reduced likelihood of −0.3 p.p. When including glycated hemoglobin (HbA1c) levels, Latin Americans and Other Europeans showed significant gaps of −2.7 p.p. and −2.0 p.p., respectively. For individuals diagnosed with diabetes in

[5] The biomarkers vector for diabetes is composed of the following glycated hemoglobin (Hb1Ac) categories: < 5.5%, 5.5%–6%, 6% - 6.5%, 6.5%–7%, > 7%. The biomarkers vector for blood pressure (BP) is: normal BP (SBP < 120 mmHg, DBP < 80 mmHg), elevated (SBP : 120–129 mmHg, DBP < 80 mmHg), hypertension stage 1 (SBP : 130–139 mmHg, DBP : 80–89 mmHg), hypertension stage 2 (SBP 140 mmHg, DBP 90 mmHg).

[6] For high blood pressure: dyslipidemia, diabetes, smoking. For diabetes: dyslipidemia, high blood pressure, smoking.

Table 2
Probability of receiving at least one prescription for antidiabetic drugs across different subsamples.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antidiabetic	Subsamples			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 HbA1c	Diabetes diagnosis
Areas of origin (ref.: Native-born)				
East Europe	−0.000	0.001	−0.035***	−0.081***
	(0.001)	(0.002)	(0.013)	(0.024)
Africa	0.000	0.006***	0.002	−0.022**
	(0.001)	(0.002)	(0.009)	(0.010)
Latin America	0.000	0.000	−0.027***	−0.066***
	(0.000)	(0.001)	(0.005)	(0.008)
Other Europe	−0.002***	−0.003***	−0.020**	−0.061***
	(0.001)	(0.001)	(0.009)	(0.018)
Asia	0.012***	0.014**	−0.012	−0.065***
	(0.003)	(0.006)	(0.016)	(0.017)
Demographics	✓	✓	✓	✓
Unrelated comorbid.	✓	✓	✓	✓
SES factors	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓
2017 Hb1Ac cat.			✓	
Individuals	906,355	447,925	106,431	84,233
Adjusted R-2	0.016	0.022	0.532	0.042
Avg predicted outcome	0.011	0.017	0.401	0.822

All models are restricted to individuals aged 39–75. Column (1) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Column (3) adds to the specification the following glycated hemoglobin (Hb1Ac) categories: < 5.5 , (5.5 - 6) , (6 - 6.5) , (6.5 −7), > 7. Hb1Ac categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of T2DM or glycated hemoglobin above 6.5 in 2018 (excluding individuals with a diagnosis of type 1 diabetes). Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3
Probability of receiving at least one prescription for antihypertensive drugs across different subsamples.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antihypertensive	Subsamples			
	Undiagn. 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis
Areas of origin (reference: Native-born)				
East Europe	0.008***	0.026***	0.041***	−0.021*
	(0.003)	(0.007)	(0.010)	(0.011)
Africa	−0.025***	−0.031***	−0.047***	−0.066***
	(0.003)	(0.006)	(0.011)	(0.010)
Latin America	−0.018***	−0.024***	−0.043***	−0.064***
	(0.002)	(0.003)	(0.005)	(0.007)
Other Europe	−0.010***	−0.005	−0.015**	−0.033***
	(0.002)	(0.004)	(0.007)	(0.007)
Asia	0.004	0.012	−0.008	−0.039**
	(0.006)	(0.013)	(0.022)	(0.018)
Demographics	✓	✓	✓	✓
Unrelated comorb.	✓	✓	✓	✓
SES factors	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓
2017 blood pressure cat.			✓	
Individuals	770,477	302,050	282,399	320,741
Adjusted R-2	0.085	0.092	0.204	0.113
Avg predicted outcome	0.081	0.140	0.489	0.646

All models are restricted to individuals aged 39–75. Column (1) reports results for individuals not diagnosed with hypertension or having blood pressure in the normal-range, as well as not treated with antihypertensive drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, diabetes, hyperlipidemia, and obesity. Column (3) adds to the specification the following blood pressure categories: normal ($SBP < 120 mmHg, DBP < 80 mmHg$), elevated ($SBP$: 120 – 129 mmHg, $DBP < 80$ mmHg), hypertension stage 1 (SBP : 130 – 139 mmHg, DBP : 80 – 89 mmHg), hypertension stage 2 ($SPBP \geqslant 140$ mmHg, $DBP \geqslant 90$ mmHg). The hypertension categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of hypertension or with the systolic blood pressure above 130 mmHg and the diastolic above 90mmHg in 2018. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4
Probability of receiving at least one prescription for antidiabetic drugs across different subsamples, only individuals with yearly income below 18,000 euros.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antidiabetic	Subsamples			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 HbA1c	Diabetes diagnosis
Areas of origin (reference: Native-born)				
East Europe	−0.000	0.001	−0.040***	−0.103***
	(0.001)	(0.002)	(0.013)	(0.024)
Africa	0.000	0.005**	0.002	−0.027**
	(0.002)	(0.003)	(0.010)	(0.011)
Latin America	−0.000	0.001	−0.030***	−0.084***
	(0.001)	(0.001)	(0.005)	(0.009)
Other Europe	−0.002***	−0.003***	−0.021**	−0.086***
	(0.001)	(0.001)	(0.010)	(0.020)
Asia	0.011***	0.014**	−0.010	−0.078***
	(0.003)	(0.006)	(0.019)	(0.022)
Demographics	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓
SES factors	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓
2017 Hb1Ac categories			✓	
Individuals	560,421	289,777	69,993	58,072
Adjusted R-2	0.017	0.024	0.535	0.032

All models are restricted to individuals aged 39–75 with an annual income below or equal to 18,000 euros. Column (1) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Column (3) adds to the specification the following glycated hemoglobin (Hb1Ac) categories: $\leq 5.5, (5.5-6), (6-6.5), (6.5-7), \geq 7$. Hb1Ac categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of T2DM or glycated hemoglobin above 6.5 in 2018 (excluding individuals with a diagnosis of type 1 diabetes). Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

2018, the strongest negative associations were observed among East Europeans (−8.1 p.p.), Latin Americans (−6.6 p.p.), and Other Europeans (−6.1 p.p.). Asians and Africans also showed significant negative pro-native gaps. These findings reveal substantial ethnic disparities in diabetes diagnosis, with some groups facing higher risks of suboptimal treatment.

Significant ethnic disparities also exist when we estimate access to hypertension treatment. Table 3 summarizes the disparities. In 2017, undiagnosed individuals from East Europe were more likely to receive treatment (+0.8 p.p.), while those from Africa (−2.5 p.p.), Latin America (−1.8 p.p.), and Other Europe (−1.0 p.p.) had lower probabilities. Among undiagnosed individuals with cardiovascular risk factors (CVDRF), East Europeans showed a higher likelihood (+2.6 p.p.), whereas Africans (−3.1 p.p.) and Latin Americans (−2.4 p.p.) had lower chances. When accounting for blood pressure levels, East Europeans remained more likely to receive treatment, while Africans, Latin Americans, and Other Europeans had reduced probabilities. For individuals diagnosed with hypertension in 2018, negative associations persisted across multiple ethnic groups, with Africans (−6.6 p.p.), Latin Americans (−6.4 p.p.), Other Europeans (−3.3 p.p.), Asians (−3.9 p.p.), and East Europeans (−2.1 p.p.) less likely to receive treatment.

We examine whether clinical check-ups for diabetes and blood pressure in 2018 align with medical needs and policy objectives. In Spain, many regions incentivize GPs to perform these assessments for specific patient groups. Tables A.3 and A.4 in the Appendix present the results: Column 1 covers the full sample (aged 39–75), Column 2 focuses on individuals undiagnosed in 2017, and Column 3 includes those undiagnosed in 2017 with at least one reported CVDRF.

Table A.3 reveals significant disparities in glycated hemoglobin testing. Individuals of African and Asian origin show positive associations, with Asians consistently more likely to be tested across all models. In contrast, individuals from "Other Europe" exhibit significant negative associations, indicating lower testing rates. Table A.4 presents mixed results for blood pressure check-ups. Individuals from Africa show higher probabilities of being tested, while Latin Americans and Other Europeans consistently exhibit lower likelihoods. In the undiagnosed hypertension subsample, East Europeans display a strong positive association, whereas Africans, Latin Americans, and Other Europeans show significant reductions. No notable associations are found for Asians in this group.

Finally, we examine prescription likelihoods for diabetes and hypertension among individuals who visited their GP at least once per semester. The results in Tables A.5 and A.6 in the Appendix closely align with the main findings.

Table A.5 shows that African and Asian individuals are more likely to receive antidiabetic medication, while East Europeans show no significant associations. Latin Americans exhibit mixed patterns, with a negative association in the HbA1c-tested subgroup. Table A.6 indicates that East Europeans are consistently more likely to receive antihypertensive medication, while Africans and Latin Americans show significant negative associations. No strong trends emerge for Asians or Other Europeans. Regarding diagnostic testing, Table A.7 finds that Asian, African, and Latin American individuals are more likely to undergo HbA1c testing, while Other Europeans show no significant differences. Table A.8 reveals higher blood pressure check rates for East Europeans and Africans but lower probabilities for Latin Americans and Other Europeans.

4.1.1. *Heterogenous effects*

Healthcare access and treatment adherence often depend on socioeconomic status. Individuals with lower incomes face barriers such as financial constraints, limited healthcare access, and structural inequalities, which can impact their likelihood of receiving appropriate medical treatment. Given that diabetes and hypertension require continuous management to prevent severe complications, understanding whether certain groups within the low-income population are systematically less likely to receive prescriptions or diagnostic checks is essential.

Table 5
Probability of receiving at least one prescription for antihypertensive drugs across different subsamples, only individuals with yearly income below 18,000 euros.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antihypertensive	Subsamples			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis
Areas of origin (reference: Native-born)				
East Europe	0.009***	0.029***	0.038***	−0.035***
	(0.003)	(0.007)	(0.012)	(0.012)
Africa	−0.026***	−0.031***	−0.050***	−0.073***
	(0.003)	(0.006)	(0.012)	(0.011)
Latin America	−0.021***	−0.025***	−0.045***	−0.076***
	(0.002)	(0.003)	(0.006)	(0.007)
Other Europe	−0.009***	−0.005	−0.022***	−0.039***
	(0.002)	(0.005)	(0.008)	(0.007)
Asia	−0.001	0.010	−0.019	−0.045**
	(0.005)	(0.014)	(0.023)	(0.019)
Demographics	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓
SES factors	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓
2017 BP categories			✓	
Individuals	477,489	200,439	186,143	206,652
Adjusted R-2	0.092	0.100	0.205	0.111

All models are restricted to individuals aged 39–75 with an annual income below or equal to 18,000 euros. Column (1) reports results for individuals not diagnosed with hypertension or having blood pressure in the normal-range, as well as not treated with antihypertensive drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, diabetes, hyperlipidemia, and obesity. Column (3) adds to the specification the following blood pressure categories: normal ($SBP < 120$ mmHg, $DBP < 80$ mmHg), elevated (SBP : $120-129$ mmHg, $DBP < 80$ mmHg), hypertension stage 1 (SBP : $130-139$ mmHg, DBP : $80-89$ mmHg), hypertension stage 2 ($SPBP \geqslant 140$ mmHg, $DBP \geqslant 90$ mmHg). The hypertension categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of hypertension or with the systolic blood pressure above 130 mmHg and the diastolic above 90mmHg in 2018. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

We analyze disparities in diabetes and hypertension treatment for individuals earning €18,000 or less (Tables 4 and 5).[7]

Table 4 shows that East and Other Europeans, as well as Latin Americans, are significantly less likely to receive antidiabetic prescriptions when diagnosed. Africans and Asians show higher prescription rates in lower-need cases but a reduced likelihood when diagnosed. For hypertension, in Table 5 East Europeans are more likely to receive antihypertensive treatment for lower levels of health needs, as well as when but less when diagnosed. Africans and Latin Americans show consistent negative associations across all subsamples, while Asians have no strong patterns. While Asians show no clear pattern, East Europeans are treated more in early stages but less when diagnosed, whereas Africans and Latin Americans consistently receive less treatment. Results are similar to those presented above, although income is not the only factor explaining persistent ethnic differences, but other factors, such as healthcare access, cultural barriers, provider bias, or differences in health-seeking behavior, may also play a role.

In Tables A.9 and A.10 in the Appendix, we present the results for the diagnostic tests related to diabetes and hypertension. We observe that HbA1c testing is more frequent among Asians and Africans, while Other Europeans are less likely to undergo testing. Blood pressure checks are lower for Latin Americans and Other Europeans, while East Europeans and Africans show mixed results.

We also focus on individuals aged 39–75 to ensure adequate representation of immigrants. This choice is motivated by their younger average age and the "salmon bias effect" which may lead to underrepresentation in older cohorts. To test sensitivity, we also analyze two age groups: 25–55 and 56–75.

Table 6 reports the probability of receiving antidiabetic prescriptions. In the 25–55 age group, Eastern Europeans show no significant differences, while for those aged 56–75, they have a lower probability of treatment. Africans aged 25–55 are more likely to receive prescriptions, whereas those aged 56–75 have a lower probability of being diagnosed. Latin Americans consistently show lower probabilities across both age groups. Other Europeans have lower probabilities in the diagnosed subgroup, and Asians show mixed results. Table A.11 in the Appendix presents glycated hemoglobin testing probabilities. Eastern Europeans have slightly higher probabilities in the younger group but lower in the older group. Africans and Latin Americans in the 25–55 age group have a higher likelihood of testing, whereas Latin Americans aged 56–75 have a lower likelihood. Other Europeans consistently show lower probabilities, while Asians have a higher likelihood in the younger group but no significant differences in the older group.

Table 7 examines antihypertensive prescriptions. Eastern Europeans aged 25–55 show a higher probability, but among those aged 56–75, results are mixed. Africans and Latin Americans generally have lower probabilities across both age groups. Other Europeans show minor negative associations, and Asians exhibit mixed results. Table A.12 reports blood pressure measurement probabilities. Younger Eastern Europeans, Africans, and Asians are more likely to have BP checked, while older Eastern Europeans and Latin Americans are less likely. Other Europeans have lower probabilities across all subsamples, and Asians in the older age group show a lower likelihood of BP checks.

After restricting the analysis to individuals aged 39–75 to ensure adequate representation of immigrants, the results remain consistent with those observed in the broader sample.

4.2. Potential mechanisms

Immigrants' lower-level likelihood of accessing care compared to native-born Spaniards could be explained by how language proficiency

[7] As mentioned earlier, income is categorized into three main thresholds. We use the first threshold of €18,000, which qualifies individuals for free medication.

Table 6
Probability of receiving at least one prescription for antidiabetic drugs across different subsamples, by age groups.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antidiabetic	Age 25–55				Age 56–75			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 HbA1c	Diabetes diagnosis	Undiagn. in 2017	Undiagn. + CVDRF	2017 HbA1c	Diabetes diagnosis
Areas of origin (ref.: Native-born)								
East Europe	0.000	0.000	−0.011	−0.060	−0.002	0.001	−0.050**	−0.089**
	(0.000)	(0.001)	(0.013)	(0.032)	(0.002)	(0.004)	(0.018)	(0.028)
Africa	0.003***	0.009***	0.009	−0.003	−0.001	0.005	−0.007	−0.045**
	(0.001)	(0.002)	(0.010)	(0.013)	(0.004)	(0.005)	(0.014)	(0.014)
Latin America	0.000	0.001	−0.023***	−0.042***	0.000	0.001	−0.025**	−0.078***
	(0.000)	(0.001)	(0.004)	(0.012)	(0.001)	(0.002)	(0.008)	(0.009)
Other Europe	−0.001	−0.002	0.000	−0.055*	−0.002	−0.002	−0.040**	−0.063**
	(0.000)	(0.001)	(0.007)	(0.023)	(0.001)	(0.002)	(0.013)	(0.021)
Asia	0.009***	0.015**	−0.017	−0.071**	0.012*	0.012	−0.010	−0.049
	(0.001)	(0.004)	(0.017)	(0.026)	(0.006)	(0.010)	(0.027)	(0.026)
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓	✓	✓
2017 Hb1Ac categories			✓				✓	
Adjusted R2	0.005	0.008	0.601	0.039	0.023	0.030	0.493	0.039
Clusters	139	139	125	139	139	139	133	139
Observations	884,087	281,011	40,302	18,875	399,589	263,349	79,934	71,368

The analysis is stratified by age group: individuals aged 25–55 in Columns (1)-(4) and individuals aged 56-75 in Columns (5)-(8). Column (1) and (5) report results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (2) and (6) restrict the subsample of Column (1) and (5) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Column (3) and (7) add to the specification the following glycated hemoglobin (Hb1Ac) categories: < 5.5 , (5.5 - 6) , (6 - 6.5) , (6.5 −7), > 7. Hb1Ac categories used in Column (3) are from 2017 (previous year). Column (4) and (8) report results for the subsample of patients with an active diagnosis of T2DM or glycated hemoglobin above 6.5 in 2018 (excluding individuals with a diagnosis of type 1 diabetes). Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7
Probability of receiving at least one prescription for antihypertensive drugs across different subsamples, by age groups.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antihypertensive	Age 25–55				Age 56–75			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis	Undiagn. in 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis
Areas of origin (ref.: Native-born)								
East Europe	0.008***	0.016**	0.036***	0.023	0.003	0.031*	0.041*	−0.050**
	(0.002)	(0.005)	(0.008)	(0.014)	(0.007)	(0.014)	(0.018)	(0.015)
Africa	−0.006***	−0.008*	−0.009	−0.037**	−0.055***	−0.063***	−0.077***	−0.081***
	(0.001)	(0.003)	(0.008)	(0.012)	(0.010)	(0.014)	(0.017)	(0.012)
Latin America	−0.005***	−0.007**	−0.007	−0.019*	−0.039***	−0.047***	−0.069***	−0.092***
	(0.001)	(0.002)	(0.004)	(0.008)	(0.004)	(0.005)	(0.007)	(0.007)
Other Europe	−0.001	−0.001	−0.009	−0.024**	−0.021***	−0.005	−0.014	−0.043***
	(0.001)	(0.003)	(0.007)	(0.009)	(0.004)	(0.008)	(0.011)	(0.009)
Asia	−0.002	−0.006	0.006	−0.034	0.027	0.054*	−0.029	−0.041*
	(0.002)	(0.007)	(0.014)	(0.021)	(0.015)	(0.025)	(0.030)	(0.019)
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓	✓	✓
2017 blood pressure cat.			✓				✓	
Adjusted R2	0.031	0.040	0.193	0.137	0.072	0.071	0.100	0.057
Clusters	139	139	139	139	139	139	139	139
Observations	846,154	236,426	154,857	122,351	292,849	151,074	192,780	235,885

The analysis is stratified by age group: individuals aged 25–55 in Columns (1)-(4) and individuals aged 56–75 in Columns (5)-(8). Column (1) and (5) report results for individuals not diagnosed with hypertension or having blood pressure in the normal-range, as well as not treated with antihypertensive drugs in 2017. Column (2) and (6) restrict the subsample of Column (1) and (5) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, diabetes, hyperlipidemia, and obesity. Column (3) and (7) add to the specification the following blood pressure categories: normal ($SBP < 120$ mmHg, $DBP < 80$ mmHg), elevated ($SBP : 120 - 129$ mmHg, $DBP < 80$ mmHg), hypertension stage 1 ($SBP : 130 - 139$ mmHg, $DBP : 80 - 89$ mmHg), hypertension stage 2 ($SPBP \geqslant 140$ mmHg, $DBP \geqslant 90$ mmHg). The hypertension categories used in Column (3) and (7) are from 2017 (previous year). Column (4) and (8) report results for the subsample of patients with an active diagnosis of hypertension or with the systolic blood pressure above 130 mmHg and the diastolic above 90 mmHg in 2018. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

affects immigrants' healthcare access. Understanding such barriers is crucial for addressing health inequities and Spain offers a unique setting to test whether language concordance facilitates healthcare access, as Latin immigrants share the native language while other immigrants do not. We therefore compare Latin and non-Latin immigrants with natives (reference category) in the access to diabetes and hypertension checks and treatments. Results reveal that Latin immigrants face significant disparities in diabetes treatment access, particularly among high-need subsamples, and are less likely to receive diabetic medications compared to both natives and non-Latin immigrants (Table A.13 of the Appendix). Similarly, for hypertension treatment, Latin immigrants show consistently lower access than both comparison groups (Table A.14 of the Appendix). The regression results in Table A.15 of the Appendix show that, across there are no significant differences for Latin immigrants and no significant differences for non-Latin immigrants, both compared to native Spaniards, in the probability of having glycated hemoglobin checked across different subsamples. Finally, concerning blood pressure checks, the regression results in Table A.16 of the Appendix show that there are negative pro-native gaps for lower levels of needs in the whole sample, for both Latin immigrants and non-Latin immigrants, although no significant difference is reported among the previously undiagnosed samples. These findings contradict the hypothesis that shared language facilitates healthcare access, as Latin immigrants exhibit larger healthcare access differentials than other immigrants. This suggests that factors beyond language barriers drive healthcare disparities among immigrant populations, warranting further investigation into other potential barriers.

Furthermore, healthcare provision may vary across territories in Spain's National Health System, where regions (Autonomous Communities) manage healthcare services. While our analysis controls for primary care center fixed effects to capture local care provision characteristics, town size could affect healthcare access disparities between immigrants and natives, as larger towns may better accommodate minorities' needs. We test this by stratifying our analysis between towns with populations above and below 50,000 inhabitants (Tables A.17–A.20 of the Appendix). Most immigrant groups are concentrated in larger towns: 71.24% of East Europeans, 65.96% of Africans, 78.49% of Latin Americans, 57.39% of Other Europeans, and 68.86% of Asians, compared to 62.02% of natives. Results show that disparities in anti-diabetic treatment access generally widen in larger towns. For anti-hypertensive medications, Latin Americans and Other Europeans face larger disparities in bigger towns, while Africans experience greater disparities in smaller towns. Despite these variations, significant migration-related healthcare access disparities persist across both town sizes. To better identify regional differences across the Spanish territory, we repeat the analysis on the Madrid Region separately from the rest of Spain. We show that even though some differences exist (again likely to be related to both the provision of care and the distribution of immigrant groups across regions), we can still document most of the differentials discussed in the main analysis. Results are in Tables A.21–A.24 of Appendix. It seems therefore unlikely that the effect is driven by the inclusion of the Madrid region in the sample.

5. Discussion

Diabetes medication access shows significant negative gaps, especially for Eastern Europeans, Latin Americans, Asians, and Other Europeans with higher needs. However, undiagnosed Africans and Asians experience positive pro-immigrant gaps. Disparities are most pronounced among low-SES and older individuals. Notably, among those with at least one medical visit per semester, no significant negative gaps remain, and treatment levels for Africans and Latin Americans even surpass natives. This suggests that frequent care seekers face minimal migration-related disparities, while some Other Europeans may seek treatment in their home countries.

Antihypertensive prescriptions show significant negative gaps for Africans, Latin Americans, Other Europeans, and diagnosed Asians, while East Europeans experience positive gaps that disappear in diagnosed cases. Disparities are more pronounced among low-SES individuals and those aged 56–75. However, among those with at least one medical visit per semester, most gaps persist except for Other Europeans, whose differences with natives become insignificant.

Other Europeans face significant negative gaps in glycaemic and blood pressure checks, with Latin Americans also disadvantaged in blood pressure measurements. However, Asians consistently have higher probabilities of glycated hemoglobin testing. For Africans, results are mixed: they show positive gaps in glycaemic checks overall and in those with CVRDFs, as well as higher BP measurement rates at lower need levels, but negative gaps for undiagnosed individuals with CVRDFs. Negative pro-native gaps in glycaemic control and blood pressure checks are more pronounced among lower-SES and older individuals. Among those with at least one visit per semester, disparities for Other Europeans disappear, while positive gaps for Asians, Africans, and Latin Americans emerge with more frequent visits. Latin immigrants show greater healthcare disparities than non-Latin groups, suggesting factors beyond language. Migration-related inequalities persist across regions, indicating systemic issues rather than Madrid-specific effects.

To examine the role of language barriers in healthcare access, we specifically divided the immigrant population into Latin and non-Latin groups. Latin immigrants display greater healthcare access differentials compared to other immigrant groups. This approach suggests that factors beyond language barriers contribute to healthcare disparities, emphasizing the need to investigate additional potential obstacles.

Significant migration-related healthcare access disparities persist in both large and small towns, reflecting the systemic nature of these inequalities. Furthermore, while some differences are observed between Madrid and the rest of Spain, most of the migration-related disparities highlighted in the main analysis are consistently documented across both areas. This suggests that the observed effects are unlikely to be solely attributable to the inclusion of Madrid in the sample.

Healthcare disparities in Spain differ from other countries due to distinct migration patterns (Meeks et al., 2016; Marchesini et al., 2014; Seghieri et al., 2019). Immigrants diagnosed with diabetes are less likely to receive treatment than natives, with East Europeans, Latin Americans, and Other Europeans also facing lower prescription rates. Asians, however, are more likely to receive treatment. These findings align with reports of suboptimal diabetes management among immigrants in Europe (Agyemang et al., 2021; Marchesini et al., 2014). Other Europeans undergo fewer glycaemic checks than natives, while Asians are more likely to be tested. Africans show higher testing rates overall but mixed results for blood pressure checks. These trends support improved access for first-generation migrants (Agyemang et al., 2021) but contrast with findings of reduced glycaemic control in Italy (Seghieri et al., 2019). Fontil et al. (2022) examines racial disparities in hypertension management in the US. Africans and Latin Americans are consistently less likely to receive treatment, while East Europeans show mixed patterns, echoing UK barriers (Mathur et al., 2020). Latin Americans and Other Europeans have lower blood pressure check rates than natives, whereas Africans show higher rates except among undiagnosed individuals with other CVD risk factors.

East Europeans have higher BP checks only in undiagnosed cases. These trends align with UK findings of poorer blood pressure control among non-European minorities despite higher treatment rates (Fontil et al., 2022; Eastwood et al., 2022).

6. Conclusions

As immigration rates rise, promoting health equity across social groups becomes a critical public health concern. Previous studies have generally identified a higher prevalence of diabetes and hypertension among ethnic minorities and individuals with migration backgrounds. Differentials in healthcare access for diabetes and hypertension among ethnic minorities and individuals with a migration background have also been documented.

We contribute to this literature by leveraging individual electronic health records from Spain to investigate migration-related barriers in healthcare access for diabetes and hypertension. Our analysis is stratified by levels of healthcare needs. In order to define the strata, we exploited individual-level information on present and past diagnoses, prescriptions and biomarkers measurements.

Our findings reveal that certain immigrant groups have a lower probability of receiving treatment for these risk factors compared to other population segments. The results of our study reflect broader findings that low-income immigrant groups, particularly in high-income countries like Italy and the UK, face compounded disadvantages due to income, ethnic background, and immigrant status (Marchesini et al., 2014; Mathur et al., 2020). Our estimates account for various medical need dimensions, including demographics, multimorbidities, and biomarker parameters, alongside socioeconomic status. Additionally, we control for spatially correlated unobservables by incorporating fixed effects for primary care centers.

We identify both positive pro-immigrant and negative pro-native gaps in healthcare access. Positive gaps may reflect higher medical needs among immigrants from regions with a greater CVD burden (Vaduganathan et al., 2022) or the impact of targeted healthcare campaigns. Negative pro-native gaps are concerning, as factors like housing segregation, labor market discrimination, and distrust in healthcare institutions may hinder immigrants' healthcare-seeking behavior (Munshi, 2016; Andersen, 2019; Steil and Arcaya, 2023). Addressing these gaps is essential for equitable healthcare. To mitigate endogeneity concerns, we use 2017 biomarkers and diagnoses, ensuring 2018 prescriptions do not influence health need classification. Sensitivity analysis confirms robustness by excluding individuals with fewer than one medical visit per semester, reducing biases from those seeking care abroad or lacking medical necessity.

This study has limitations. First, sample selection bias may occur as we only observe individuals who accessed primary healthcare, potentially underestimating health issues among those who never sought care. While we focus on first diagnoses and recorded visits, individuals who did not interact with primary care due to excellent health or access barriers remain unobserved. Future research could explore complementary data sources to capture a broader picture of healthcare utilization. The grouping of immigrants into five ethnic categories (East Europeans, Africans, Latin Americans, Other Europeans, Asians) may oversimplify cultural diversity. Our socioeconomic measures lack educational attainment data, which is an important health demand determinant (Grossman, 1972), and we lack information on private health insurance, which impacts healthcare utilization (Spanish Health Ministry, 2024). Data limitations include single annual biomarker measurements and the absence of cultural preference indicators. Lastly, we cannot observe secondary care or emergency department visits, which are especially relevant for non-Spanish populations (Credé et al., 2018).

However, by analyzing prescription patterns for diabetes and blood pressure, we demonstrate that the complexities of healthcare inequalities require multifaceted investigations. By examining treatment disparities across different levels of medical necessity, treatment initiation among previously undiagnosed individuals, and the achievement of glycaemic and blood pressure control, we contribute valuable insights for evidence-based policy-making and improved healthcare practices. Such disparities necessitate targeted interventions for effective prevention and management of cardiovascular diseases. Importantly, the Spanish context, characterized by a healthcare system largely free of financial barriers, allows to highlight the importance of non-financial obstacles in healthcare access.

CRediT authorship contribution statement

Luigi Boggian: Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Joan E. Madia:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Catia Nicodemo:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

See Fig. 1 and Tables A.1–A.24.

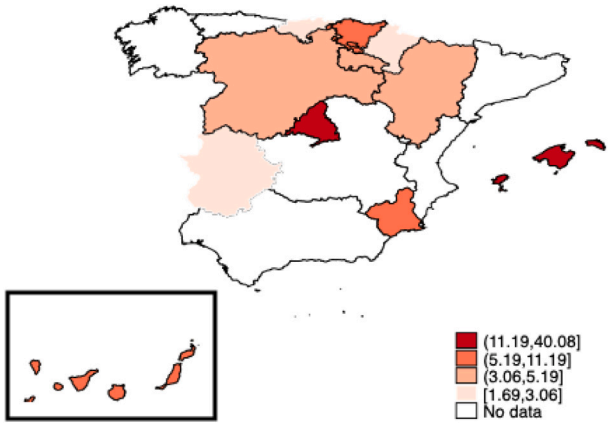

Fig. 1. Distribution of shares of immigrants across Spanish autonomous communities in the study sample.

Table A.1
Distribution of diabetes classification across native-born and immigrant groups in the study sample, by age group.

Age group	N	Level of need	Glycated hemoglobin	Native-born	Immigrants
18-34 years	6,862	Normal level	$HbA1c < 5.7\%$	88.95%	88.08%
		Pre-diabetes	$5.7\% < HbA1c < 6.5\%$	3.53%	6.64%
		Diabetes	$HbA1c > 6.5\%$	7.52%	5.28%
35-64 years	76,241	Normal level	$HbA1c < 5.7\%$	54.20%	52.30%
		Pre-diabetes	$5.7\% < HbA1c < 6.5\%$	23.66%	25.16%
		Diabetes	$HbA1c > 6.5\%$	22.14%	22.53%
65 years and older	103,559	Normal level	$HbA1c < 5.7\%$	32.27%	35.79%
		Pre-diabetes	$5.7\% < HbA1c < 6.5\%$	34.27%	33.83%
		Diabetes	$HbA1c > 6.5\%$	33.46%	30.37%

Table A.2
Distribution of blood pressure classification across native and immigrant groups in the study sample, by age group.

Age group	N	Systolic range	Diastolic range	Level of need	Native-born	Immigrants
18-34 years	38,835	< 120 mmHg	< 80 mmHg	Normal	48.70%	52.98%
		120-129 mmHg	< 80 mmHg	Elevated	17.14%	16.63%
		130-139 mmHg	80-89 mmHg	Hypertension stage 1	24.38%	22.60%
		≥ 140 mmHg	≥ 90 mmHg	Hypertension stage 2	9.78%	7.79%
35-64 years	200,617	< 120 mmHg	< 80 mmHg	Normal	22.76%	27.95%
		120-129 mmHg	< 80 mmHg	Elevated	13.04%	14.27%
		130-139 mmHg	80-89 mmHg	Hypertension stage 1	36.13%	33.40%
		≥ 140 mmHg	≥ 90 mmHg	Hypertension stage 2	28.07%	24.38%
65 years and older	236,863	< 120 mmHg	< 80 mmHg	Normal	12.81%	14.29%
		120-129 mmHg	< 80 mmHg	Elevated	15.96%	15.46%
		130-139 mmHg	80-89 mmHg	Hypertension stage 1	31.97%	32.33%
		≥ 140 mmHg	≥ 90 mmHg	Hypertension stage 2	39.26%	37.92%

Table A.3
Probability of having glycated hemoglobin checked in 2018.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Glycaemic control	Subsamples		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (reference: Native-born)			
East Europe	−0.002	0.004	0.005
	(0.004)	(0.003)	(0.006)
Africa	0.012***	0.001	0.010**
	(0.003)	(0.002)	(0.005)
Latin America	−0.002	0.001	0.006**
	(0.002)	(0.002)	(0.003)
Other Europe	−0.020***	−0.011***	−0.012***
	(0.004)	(0.003)	(0.004)
Asia	0.041***	0.025***	0.032**
	(0.006)	(0.006)	(0.014)
Demographics	✓	✓	✓
Unrelated multimorbities	✓	✓	✓
SES factors	✓	✓	✓
PCC FE	✓	✓	✓
Individuals	986,314	906,355	447,925
Adjusted R-2	0.095	0.069	0.063
Avg Predicted Outcome	0.122	0.084	0.130

All models are restricted to individuals aged 39–75. Column (1) reports results for all individuals in the sample. Column (2) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.4
Probability of having blood pressure measured in 2018.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Blood pressure	Subsamples		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (reference: Native-born)			
East Europe	−0.004	0.002	0.049***
	(0.006)	(0.005)	(0.008)
Africa	0.013***	0.017***	−0.036***
	(0.004)	(0.004)	(0.009)
Latin America	−0.016***	−0.006**	−0.048***
	(0.003)	(0.003)	(0.005)
Other Europe	−0.051***	−0.037***	−0.032***
	(0.007)	(0.005)	(0.006)
Asia	0.004	0.014*	−0.006
	(0.009)	(0.008)	(0.015)
Demographics	✓	✓	✓
Unrelated multimorbities	✓	✓	✓
SES factors	✓	✓	✓
PCC FE	✓	✓	✓
Individuals	986,314	770,477	467,519
Adjusted R-2	0.175	0.136	0.179
Avg predicted outcome	0.285	0.213	0.399

All models are restricted to individuals aged 39–75. Column (1) reports results for the whole sample. Column (2) reports results for the subsample of individuals who in 2017 were undiagnosed with hypertension, had SBP below 130 mmHg and the DBP below 90mmHg. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor: smoking, diabetic, hyperlipidemia, and obesity. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.5
Probability of receiving at least one prescription for antidiabetic drugs across different subsamples, at least one contact with medical staff per semester.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antidiabetic	Subsamples			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 HbA1c	Diabetes diagnosis
Areas of origin (reference: Native-born)				
East Europe	0.002	0.002	−0.033*	0.005
	(0.003)	(0.004)	(0.018)	(0.027)
Africa	0.006**	0.009**	0.017*	0.021**
	(0.003)	(0.004)	(0.010)	(0.009)
Latin America	0.002*	0.002	−0.025***	0.012*
	(0.001)	(0.002)	(0.007)	(0.007)
Other Europe	−0.002	−0.003	−0.009	0.015
	(0.002)	(0.002)	(0.011)	(0.013)
Asia	0.022***	0.026***	−0.006	0.016
	(0.007)	(0.010)	(0.016)	(0.018)
Demographics	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓
SES factors	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓
2017 Hb1Ac categories			✓	
Individuals	354,419	240,856	73,166	61,036
Adjusted R-2	0.021	0.027	0.527	0.035

All models are restricted to individuals aged 39–75 with at least one contact with the medical staff per semester in 2018. Column (1) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Column (3) adds to the specification the following glycated hemoglobin (Hb1Ac) categories: $\leq 5.5, (5.5-6), (6-6.5), (6.5-7), \geq 7$. Hb1Ac categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of T2DM or glycated hemoglobin above 6.5 in 2018 (excluding individuals with a diagnosis of type 1 diabetes). Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.6
Probability of receiving at least one prescription for antihypertensive drugs across different subsamples, at least one contact with medical staff per semester.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antihypertensive	Subsamples			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis
Areas of origin (reference: Native-born)				
East Europe	0.044***	0.054***	0.073***	0.048***
	(0.008)	(0.013)	(0.016)	(0.015)
Africa	−0.041***	−0.048***	−0.053***	−0.057***
	(0.006)	(0.009)	(0.013)	(0.013)
Latin America	−0.022***	−0.030***	−0.050***	−0.033***
	(0.003)	(0.004)	(0.007)	(0.008)
Other Europe	−0.002	0.002	0.001	−0.002
	(0.005)	(0.007)	(0.009)	(0.010)
Asia	0.005	0.010	−0.017	−0.008
	(0.012)	(0.020)	(0.024)	(0.022)
Demographics	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓
SES factors	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓
2017 blood pressure cat.			✓	
Individuals	275,524	157,214	185,209	206,752
Adjusted R-2	0.088	0.092	0.176	0.103

All models are restricted to individuals aged 39–75 with at least one contact with the medical staff per semester in 2018. Column (1) reports results for individuals not diagnosed with hypertension or having blood pressure in the normal-range, as well as not treated with antihypertensive drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, diabetes, hyperlipidemia, and obesity. Column (3) adds to the specification the following blood pressure categories: normal ($SBP < 120$ mmHg, $DBP < 80$ mmHg), elevated ($SBP: 120-129$ mmHg, $DBP < 80$ mmHg), hypertension stage 1 ($SBP: 130-139$ mmHg, $DBP: 80-89$ mmHg), hypertension stage 2 ($SPBP \geqslant 140$ mmHg, $DBP \geqslant 90$ mmHg). The hypertension categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of hypertension or with the systolic blood pressure above 130 mmHg and the diastolic above 90mmHg in 2018. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.7
Probability of having glycated hemoglobin checked in 2018, at least one contact with medical staff per semester.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Glycaemic control	Subsamples		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (reference: Native-born)			
East Europe	0.016	0.017*	0.018
	(0.009)	(0.008)	(0.012)
Africa	0.041***	0.010*	0.018*
	(0.005)	(0.005)	(0.007)
Latin America	0.020***	0.017***	0.021***
	(0.005)	(0.004)	(0.005)
Other Europe	−0.012	−0.002	0.000
	(0.007)	(0.005)	(0.006)
Asia	0.096***	0.064***	0.056**
	(0.015)	(0.015)	(0.021)
Demographics	✓	✓	✓
Unrelated multimorbities	✓	✓	✓
SES factors	✓	✓	✓
PCC FE	✓	✓	✓
Adjusted R2	0.090	0.071	0.069
Clusters	139	139	139
Observations	411,997	354,419	240,856

All models are restricted to individuals aged 39–75 with at least one contact with the medical staff per semester in 2018. Column (1) reports results for all individuals in the sample. Column (2) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.8
Probability of having blood pressure measured in 2018, at least one contact with medical staff per semester.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Blood pressure	Subsamples		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (reference: Native-born)			
East Europe	0.035**	0.042**	0.087***
	(0.012)	(0.013)	(0.014)
Africa	0.038***	0.043***	−0.048***
	(0.007)	(0.007)	(0.010)
Latin America	0.009	0.020***	−0.050***
	(0.005)	(0.005)	(0.006)
Other Europe	−0.037***	−0.025*	−0.018*
	(0.011)	(0.011)	(0.009)
Asia	0.022	0.037*	−0.001
	(0.018)	(0.017)	(0.020)
Demographics	✓	✓	✓
Unrelated multimorbities	✓	✓	✓
SES factors	✓	✓	✓
PCC FE	✓	✓	✓
Adjusted R2	0.129	0.104	0.156
Clusters	139	139	139
Observations	411,997	275,524	270,495

All models are restricted to individuals aged 39–75 with at least one contact with the medical staff per semester in 2018. Column (1) reports results for the whole sample. Column (2) reports results for the subsample of individuals who in 2017 were undiagnosed with hypertension, had SBP below 130 mmHg and the DBP below 90mmHg. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor: smoking, diabetic, hyperlipidemia, and obesity. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.9
Probability of having glycated hemoglobin checked in 2018, only individuals with yearly income below 18,000 euros.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Glycaemic control	Subsamples		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (reference: Native-born)			
East Europe	−0.005	0.002	0.002
	(0.004)	(0.003)	(0.006)
Africa	0.012***	0.000	0.008
	(0.003)	(0.003)	(0.005)
Latin America	−0.004	−0.001	0.005
	(0.003)	(0.002)	(0.003)
Other Europe	−0.026***	−0.014***	−0.017***
	(0.005)	(0.004)	(0.005)
Asia	0.039***	0.022***	0.026
	(0.007)	(0.006)	(0.014)
Demographics	✓	✓	✓
Unrelated multimorbities	✓	✓	✓
SES factors	✓	✓	✓
PCC FE	✓	✓	✓
Adjusted R2	0.095	0.070	0.065
Clusters	139	139	139
Observations	615,776	560,421	289,777

All models are restricted to individuals aged 39–75 with an annual income below or equal to 18,000 euros. Column (1) reports results for all individuals in the sample. Column (2) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.10
Probability of having blood pressure measured in 2018, only individuals with yearly income below 18,000 euros.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Blood pressure	Subsamples		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (reference: Native-born)			
East Europe	−0.003	0.004	0.050***
	(0.006)	(0.005)	(0.008)
Africa	0.016***	0.019***	−0.037***
	(0.005)	(0.004)	(0.009)
Latin America	−0.017***	−0.008*	−0.051***
	(0.004)	(0.003)	(0.005)
Other Europe	−0.062***	−0.047***	−0.035***
	(0.008)	(0.006)	(0.006)
Asia	0.015	0.023*	−0.004
	(0.010)	(0.009)	(0.016)
Demographics	✓	✓	✓
Unrelated multimorbities	✓	✓	✓
SES factors	✓	✓	✓
PCC FE	✓	✓	✓
Adjusted R2	0.180	0.140	0.186
Clusters	139	139	139
Observations	615,776	477,489	308,789

All models are restricted to individuals aged 39–75 with an annual income below or equal to 18,000 euros. Column (1) reports results for the whole sample. Column (2) reports results for the subsample of individuals who in 2017 were undiagnosed with hypertension, had SBP below 130 mmHg and the DBP below 90mmHg. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor: smoking, diabetic, hyperlipidemia, and obesity. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.11
Probability of having glycated hemoglobin checked across different subsamples, by age groups.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Glycaemic control	Ages 25–55			Ages 56–75		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (ref.: Native-born)						
East Europe	0.006**	0.005*	0.006	−0.019*	−0.002	−0.004
	(0.002)	(0.002)	(0.005)	(0.007)	(0.007)	(0.009)
Africa	0.015***	0.007***	0.018***	0.010	−0.007	0.002
	(0.002)	(0.001)	(0.004)	(0.007)	(0.005)	(0.008)
Latin America	0.006***	0.006***	0.013***	−0.018***	−0.008*	−0.003
	(0.001)	(0.001)	(0.003)	(0.004)	(0.004)	(0.005)
Other Europe	−0.005*	−0.004	−0.008**	−0.046***	−0.024***	−0.020*
	(0.002)	(0.002)	(0.003)	(0.008)	(0.007)	(0.008)
Asia	0.037***	0.027***	0.049***	0.029	0.014	0.012
	(0.006)	(0.005)	(0.010)	(0.015)	(0.014)	(0.021)
Demographics	✓	✓	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓
Adjusted R2	0.048	0.042	0.043	0.078	0.067	0.062
Clusters	139	139	139	139	139	139
Observations	904,541	884,087	281,011	466,278	399,589	263,349

The analysis is stratified by age group: individuals aged 25–55 in Columns (1)-(3) and individuals aged 56–75 in Columns (4)-(6). Column (1) ad (4) report results for all individuals in the sample. Column (2) and (5) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (3) and (6) restricts the subsample of Column (2) and (5) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.12
Probability of having blood pressure measured across different subsamples, by age group.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Blood pressure	Age 25–55			Age 56–75		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (ref.: Native-born)						
East Europe	0.018***	0.014***	0.020*	−0.038***	−0.019	−0.026
	(0.005)	(0.004)	(0.009)	(0.011)	(0.010)	(0.015)
Africa	0.038***	0.038***	0.076***	−0.011	−0.001	0.019
	(0.004)	(0.004)	(0.008)	(0.008)	(0.008)	(0.011)
Latin America	0.004	0.004	0.014**	−0.056***	−0.033***	−0.042***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.007)
Other Europe	−0.019***	−0.015***	−0.019*	−0.089***	−0.067***	−0.091***
	(0.004)	(0.004)	(0.007)	(0.009)	(0.007)	(0.014)
Asia	0.036***	0.030***	0.081***	−0.045***	−0.008	−0.049**
	(0.008)	(0.008)	(0.020)	(0.013)	(0.017)	(0.017)
Demographics	✓	✓	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓
Adjusted R2	0.117	0.109	0.101	0.143	0.124	0.108
Clusters	139	139	139	139	139	139
Observations	904,541	846,154	275,448	466,278	292,849	289,321

The analysis is stratified by age group: individuals aged 25–55 in Columns (1)-(3) and individuals aged 56–75 in Columns (4)-(6). Column (1) and (3) report results for the whole sample. Column (2) and (4) report results for the subsample of individuals who in 2017 were undiagnosed with hypertension, had SBP below 130 mmHg and the DBP below 90mmHg. Column (3) and (6) restrict the subsample of Column (2) and (4) to individuals with at least one of the following CVD risk factor: smoking, diabetic, hyperlipidemia, and obesity. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.13
Probability of receiving at least one prescription for antidiabetic drugs across different subsamples, Latin vs non-Latin immigrants.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antidiabetic	Subsamples			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 Hb1Ac	Diabetes diagnosis
Areas of origin (ref.: Native-born)				
Latin immigrant	0.000	0.000	−0.028***	−0.066***
	(0.000)	(0.001)	(0.005)	(0.008)
Non-Latin immigrant	−0.000	0.001	−0.013*	−0.045***
	(0.001)	(0.001)	(0.006)	(0.009)
Demographics	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓
SES factors	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓
2017 Hb1Ac categories			✓	
Adjusted R2	0.016	0.022	0.532	0.042
Clusters	139	139	133	139
Observations	906 355	447 925	106 431	84 233
Latin = non-Latin (t-test *p*-value)	0.651	0.396	0.034	0.056

All models are restricted to individuals aged 39–75. Column (1) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Column (3) adds to the specification the following glycated hemoglobin (Hb1Ac) categories: < 5.5 , (5.5 - 6) , (6 - 6.5) , (6.5 −7), > 7. Hb1Ac categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of T2DM or glycated hemoglobin above 6.5 in 2018 (excluding individuals with a diagnosis of type 1 diabetes). Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.14
Probability of receiving at least one prescription for antihypetensive drugs across different subsamples, Latin vs non-Latin immigrants.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antihypertensive	Subsamples			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis
Areas of origin (reference: Native-born)				
Latin immigrant	−0.018***	−0.024***	−0.043***	−0.064***
	(0.002)	(0.003)	(0.005)	(0.007)
Non-Latin immigrant	−0.012***	−0.008*	−0.018**	−0.042***
	(0.002)	(0.004)	(0.006)	(0.005)
Demographics	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓
SES factors	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓
2017 blood pressure cat.			✓	
Adjusted R2	0.085	0.092	0.204	0.113
Clusters	139	139	139	139
Observations	770 477	302 050	282 399	320 741
Latin = non-Latin (t-test p-value)	0.001	0.000	0.001	0.002

All models are restricted to individuals aged 39–75. Column (1) reports results for individuals not diagnosed with hypertension or having blood pressure in the normal-range, as well as not treated with antihypertensive drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, diabetes, hyperlipidemia, and obesity. Column (3) adds to the specification the following blood pressure categories: normal ($SBP < 120$ mmHg, $DBP < 80$ mmHg), elevated ($SBP : 120 - 129$ mmHg, $DBP < 80$ mmHg), hypertension stage 1 ($SBP : 130 - 139$ mmHg, $DBP : 80 - 89$ mmHg), hypertension stage 2 ($SPBP \geqslant 140$ mmHg, $DBP \geqslant 90$ mmHg). The hypertension categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of hypertension or with the systolic blood pressure above 130 mmHg and the diastolic above 90 mmHg in 2018. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.15
Probability of having glycated hemoglobin checked across different subsamples, Latin vs non-Latin immigrants.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Glycaemic control	Subsamples		
	All sample	Undiagnosed in 2017	Undiagn. + CVDRF
Areas of origin (ref.: Native-born)			
Latin immigrant	−0.002	0.000	0.006*
	(0.002)	(0.002)	(0.003)
Non-Latin immigrant	−0.002	−0.002	0.000
	(0.003)	(0.002)	(0.003)
Demographics	✓	✓	✓
Unrelated multimorbities	✓	✓	✓
SES factors	✓	✓	✓
PCC FE	✓	✓	✓
Adjusted R2	0.095	0.069	0.063
Clusters	139	139	139
Observations	986 314	906 355	447 925
Latin = non-Latin (t-test p-value)	0.977	0.225	0.135

All models are restricted to individuals aged 39–75. Column (1) reports results for all individuals in the sample. Column (2) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.16
Probability of having blood pressure measured across different subsamples, Latin vs non-Latin immigrants.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Blood pressure	Subsamples		
	All sample	Undiagnosed in 2017	Undiagn. + CVDRF
Areas of origin (ref.: Native-born)			
Latin immigrant	−0.017***	−0.007*	−0.008
	(0.003)	(0.003)	(0.005)
Non-Latin immigrant	−0.016**	−0.007	−0.012
	(0.005)	(0.004)	(0.008)
Demographics	✓	✓	✓
Unrelated multimorbities	✓	✓	✓
SES factors	✓	✓	✓
PCC FE	✓	✓	✓
Adjusted R2	0.175	0.135	0.139
Clusters	139	139	139
Observations	986 314	770 477	467 519
Latin = non-Latin (t-test *p*-value)	0.968	0.863	0.544

All models are restricted to individuals aged 39–75. Column (1) reports results for the whole sample. Column (2) reports results for the subsample of individuals who in 2017 were undiagnosed withhypertension, had SBP below 130 mmHg and the DBP below 90 mmHg. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor: smoking, diabetic, hyperlipidemia, and obesity. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.17
Probability of receiving at least one prescription for antidiabetic drugs across different subsamples, by town size.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antidiabetic	Big towns (≥ 50,000 inhabitants)				Small towns (< 50,000 inhabitants)			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 Hb1Ac	Diabetes diagnosis	Undiagn. in 2017	Undiagn. + CVDRF	2017 Hb1Ac	Diabetes diagnosis
Areas of origin (ref: Native-born)								
East Europe	−0.001	0.000	−0.035*	−0.082**	0.001	0.004	−0.020	−0.069
	(0.001)	(0.002)	(0.017)	(0.027)	(0.002)	(0.004)	(0.019)	(0.047)
Africa	−0.000	0.006*	0.007	−0.027*	0.001	0.007	−0.002	0.000
	(0.002)	(0.003)	(0.012)	(0.011)	(0.003)	(0.005)	(0.015)	(0.020)
Latin America	0.000	0.001	−0.029***	−0.071***	0.000	0.000	−0.025*	−0.047***
	(0.001)	(0.001)	(0.006)	(0.009)	(0.001)	(0.002)	(0.011)	(0.013)
Other Europe	−0.003**	−0.004*	−0.019	−0.045	−0.002	−0.003	−0.022	−0.038*
	(0.001)	(0.002)	(0.014)	(0.026)	(0.001)	(0.002)	(0.015)	(0.016)
Asia	0.013***	0.015	−0.023	−0.041*	0.010*	0.017	0.029	−0.122**
	(0.004)	(0.008)	(0.020)	(0.020)	(0.004)	(0.010)	(0.027)	(0.046)
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
Comorbidities	✓	✓	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓	✓	✓
2017 Hb1Ac cat.			✓				✓	
Adjusted R2	0.016	0.021	0.531	0.046	0.017	0.026	0.530	0.035
Clusters	61	61	61	61	72	72	66	72
Observations	541,686	269,999	64,523	50,831	315,520	153,239	37,742	29,034

All models include individuals aged 39-75. The analysis is stratified by town size: big towns (≥ 50,000 inhabitants) vs small towns (< 50,000 inhabitants). For both strata defined by town size, we report results across the four subsamples defined by levels of need (as in the main analysis). Column (1) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Column (3) adds to the specification the following glycated hemoglobin (Hb1Ac) categories: < 5.5 , (5.5 - 6) , (6 - 6.5) , (6.5 −7), > 7. Hb1Ac categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of T2DM or glycated hemoglobin above 6.5 in 2018 (excluding individuals with a diagnosis of type 1 diabetes). Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.18
Probability of having glycated hemoglobin checked across different subsamples, by town size.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Glycaemic control	Big towns (≥ 50,000 inhabitants)			Small towns (< 50,000 inhabitants)		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (ref.: Native-born)						
East Europe	−0.001	0.006	0.011	0.004	0.004	−0.001
	(0.004)	(0.004)	(0.007)	(0.007)	(0.004)	(0.006)
Africa	0.014***	0.003	0.010	0.010	−0.004	0.009
	(0.004)	(0.003)	(0.006)	(0.006)	(0.005)	(0.010)
Latin America	−0.001	0.001	0.007	−0.001	0.000	0.006
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.006)
Other Europe	−0.018***	−0.011***	−0.015***	−0.015**	−0.009*	−0.011
	(0.005)	(0.003)	(0.004)	(0.005)	(0.004)	(0.008)
Asia	0.046***	0.030***	0.046**	0.032***	0.015	0.010
	(0.009)	(0.008)	(0.017)	(0.008)	(0.010)	(0.027)
Demographics	✓	✓	✓	✓	✓	✓
multimorbities	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓
Adjusted R2	0.087	0.062	0.052	0.111	0.084	0.082
Clusters	61	61	61	72	72	72
Observations	589,532	541,686	269,999	343,481	315,520	153,239

All models include individuals aged 39-75. The analysis is stratified by town size: big towns (≥ 50,000 inhabitants) vs small towns (< 50,000 inhabitants). For both strata defined by town size, we report results across the three subsamples defined by levels of need (as in the main analysis). Column (1) reports results for all individuals in the sample. Column (2) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.19
Probability of receiving at least one prescription for antihypertensive drugs across different subsamples, by town size.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antihypertensive	Big towns (≥ 50,000 inhabitants)				Small towns (< 50,000 inhabitants)			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis	Undiagn. in 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis
Areas of origin (ref.: Native-born)								
East Europe	0.007	0.025**	0.026*	−0.035**	0.011*	0.031*	0.082***	0.007
	(0.004)	(0.008)	(0.011)	(0.012)	(0.005)	(0.014)	(0.022)	(0.024)
Africa	−0.025***	−0.028***	−0.031*	−0.050***	−0.025***	−0.036**	−0.079***	−0.098***
	(0.004)	(0.008)	(0.015)	(0.013)	(0.005)	(0.012)	(0.015)	(0.015)
Latin America	−0.019***	−0.027***	−0.052***	−0.075***	−0.013**	−0.012*	−0.022*	−0.043***
	(0.002)	(0.003)	(0.007)	(0.009)	(0.004)	(0.006)	(0.010)	(0.011)
Other Europe	−0.012***	−0.010	−0.020*	−0.050***	−0.006	−0.002	−0.011	−0.022
	(0.002)	(0.006)	(0.009)	(0.009)	(0.004)	(0.009)	(0.012)	(0.011)
Asia	0.004	0.008	0.007	−0.029	0.013	0.050*	−0.011	−0.039
	(0.007)	(0.013)	(0.025)	(0.022)	(0.008)	(0.022)	(0.025)	(0.025)
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
multimorbities	✓	✓	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓	✓	✓
2017 BP cat.			✓				✓	
Adjusted R2	0.085	0.087	0.204	0.112	0.087	0.102	0.203	0.113
Clusters	61	61	61	61	72	72	72	72
Observations	459,648	182,371	161,935	187,730	268,957	102,762	104,203	115,186

All models include individuals aged 39-75. The analysis is stratified by town size: big towns (≥ 50,000 inhabitants) vs small towns (< 50,000 inhabitants). For both strata defined by town size, we report results across the four subsamples defined by levels of need (as in the main analysis). Column (1) reports results for individuals not diagnosed with hypertension or having blood pressure in the normal-range, as well as not treated with antihypertensive drugs in 2017. Column (2) restricts the subsample of Column (1) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, diabetes, hyperlipidemia, and obesity. Column (3) adds to the specification the following blood pressure categories: normal ($SBP < 120$ mmHg, $DBP < 80$ mmHg), elevated ($SBP: 120-129$ mmHg, $DBP < 80$ mmHg), hypertension stage 1 ($SBP: 130-139$ mmHg, $DBP: 80-89$ mmHg), hypertension stage 2 ($SBP \geq 140$ mmHg, $DBP \geq 90$ mmHg). The hypertension categories used in Column (3) are from 2017 (previous year). Column (4) reports results for the subsample of patients with an active diagnosis of hypertension or with the systolic blood pressure above 130 mmHg and the diastolic above 90mmHg in 2018. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.20
Probability of having blood pressure measured across different subsamples, by town size.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Blood pressure	Big towns (≥ 50,000 inhabitants)			Small towns (< 50,000 inhabitants)		
	All sample	Undiagnosed in 2017	Undiagn. + CVDRF	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (ref.: Native-born)						
East Europe	0.002	0.007	0.006	−0.024	−0.015	−0.028
	(0.006)	(0.005)	(0.011)	(0.013)	(0.012)	(0.022)
Africa	0.015**	0.018***	0.048***	0.012	0.019*	0.032*
	(0.005)	(0.005)	(0.011)	(0.008)	(0.008)	(0.013)
Latin America	−0.013**	−0.003	−0.002	−0.023***	−0.015*	−0.016*
	(0.004)	(0.003)	(0.006)	(0.005)	(0.006)	(0.007)
Other Europe	−0.039***	−0.026***	−0.047**	−0.053***	−0.040***	−0.064***
	(0.010)	(0.007)	(0.014)	(0.010)	(0.009)	(0.018)
Asia	0.015	0.022*	0.021	−0.026	−0.009	−0.008
	(0.011)	(0.010)	(0.018)	(0.015)	(0.016)	(0.032)
Demographics	✓	✓	✓	✓	✓	✓
multimorbities	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓
Adjusted R2	0.172	0.133	0.138	0.178	0.138	0.140
Clusters	61	61	61	72	72	72
Observations	589,532	459,648	282,866	343,481	268,957	159,132

All models include individuals aged 39-75. The analysis is stratified by town size: big towns (≥ 50,000 inhabitants) vs small towns (< 50,000 inhabitants). For both strata defined by town size, we report results across the three subsamples defined by levels of need (as in the main analysis). Column (1) reports results for the whole sample. Column (2) reports results for the subsample of individuals who in 2017 were undiagnosed with hypertension, had SBP below 130 mmHg and DBP below 90 mmHg. Column (3) restricts the subsample of Column (2) to individuals with at least one of the following CVD risk factors: smoking, diabetes, hyperlipidemia, and obesity. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.21
Probability of receiving at least one prescription for antidiabetic drugs across different subsamples, by region.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Any antidiabetic	Madrid region				Rest of Spain			
	Undiagn. in 2017	Undiagn. + CVDRF	2017 Hb1Ac	Diabetes diagnosis	Undiagn. in 2017	Undiagn. + CVDRF	2017 Hb1Ac	Diabetes diagnosis
Areas of origin (ref.: Native-born)								
East Europe	−0.002	−0.002	−0.054*	−0.135***	0.001	0.003	−0.020	−0.042
	(0.001)	(0.003)	(0.021)	(0.028)	(0.001)	(0.003)	(0.016)	(0.030)
Africa	0.006***	0.014***	0.012	−0.023	−0.002	0.002	−0.003	−0.021
	(0.001)	(0.003)	(0.018)	(0.016)	(0.002)	(0.003)	(0.010)	(0.013)
Latin America	0.001	0.002	−0.034***	−0.077***	−0.000	−0.001	−0.022***	−0.056***
	(0.001)	(0.001)	(0.008)	(0.011)	(0.001)	(0.001)	(0.006)	(0.011)
Other Europe	−0.002*	−0.002	−0.008	−0.008	−0.002**	−0.004*	−0.023*	−0.071***
	(0.001)	(0.002)	(0.017)	(0.033)	(0.001)	(0.001)	(0.010)	(0.020)
Asia	0.017***	0.024*	0.008	−0.032	0.009**	0.008	−0.025	−0.084**
	(0.004)	(0.010)	(0.029)	(0.025)	(0.003)	(0.006)	(0.018)	(0.025)
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
multimorbities	✓	✓	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓	✓	✓
2017 Hb1Ac cat.			✓				✓	
Adjusted R2	0.007	0.006	0.531	0.045	0.019	0.029	0.533	0.040
Clusters	27	27	27	27	112	112	106	112
Observations	270,369	131,072	30,013	23,288	635,986	316,853	76,418	60,945

All models include individuals aged 39-75. The analysis is stratified by regions, comparing estimates for the Madrid region to those of the rest of Spain. For both parts of Spain, we report results across the four subsamples defined by levels of need (as in the main analysis). Columns (1)-(4) report results for the Madrid region. Columns (5)-(8) report results for the rest of Spain. Columns (1) and (4) reports results for individuals who were not diagnosed with T2DM or with glycated hemoglobin below 6.5, as well as not treated with antidiabetic drugs in 2017. Columns (2) and (5) restrict the subsamples of Columns (1) and (4) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, hypertension, hyperlipidemia, and obesity. Columns (3) and (6) adds to the specification the following glycated hemoglobin (Hb1Ac) categories: < 5.5 , (5.5 - 6) , (6 - 6.5) , (6.5 −7), > 7. Hb1Ac categories used in Column (3) are from 2017 (previous year). Column (4) and (8) report results for the subsample of patients with an active diagnosis of T2DM or glycated hemoglobin above 6.5 in 2018 (excluding individuals with a diagnosis of type 1 diabetes). Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.22
Probability of having glycated hemoglobin checked across different subsamples, by region.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Glycaemic control	Madrid region			Rest of Spain		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (ref.: Native-born)						
East Europe	−0.001	0.008	0.016	−0.002	0.001	−0.004
	(0.005)	(0.005)	(0.010)	(0.005)	(0.004)	(0.006)
Africa	0.028***	0.014**	0.025**	0.006	−0.004	0.002
	(0.006)	(0.004)	(0.008)	(0.003)	(0.003)	(0.006)
Latin America	0.005	0.004	0.011*	−0.006	−0.002	0.003
	(0.003)	(0.003)	(0.005)	(0.004)	(0.003)	(0.004)
Other Europe	−0.015***	−0.009**	−0.012*	−0.022***	−0.011**	−0.013*
	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.005)
Asia	0.065***	0.047***	0.067**	0.027***	0.013*	0.010
	(0.008)	(0.010)	(0.023)	(0.007)	(0.006)	(0.013)
Demographics	✓	✓	✓	✓	✓	✓
Comorbidities	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓
Adjusted R2	0.078	0.054	0.036	0.103	0.076	0.075
Clusters	27	27	27	112	112	112
Observations	293.277	270.369	131.072	693.037	635.986	316.853

All models include individuals aged 39-75. The analysis is stratified by regions, comparing estimates for the Madrid region to those of the rest of Spain. For both parts of Spain, we report results across the three subsamples defined by levels of need (as in the main analysis). Columns (1)-(3) report results for the Madrid region. Columns (4)-(6) report results for the rest of Spain. Column definitions: (1) and (4) include all individuals in the sample. (2) and (5) include individuals not diagnosed with T2DM or with glycated hemoglobin below 6.5 and not treated with antidiabetic drugs in 2017. (3) and (6) restrict the subsample to individuals with at least one CVD risk factor (smoking, hypertension, hyperlipidemia, obesity) in 2017. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.23
Probability of receiving at least one prescription for antihypertensive drugs across different subsamples, by region.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Variables of control	Madrid				Rest of Spain			
	Undiagn. 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis	Undiagn. 2017	Undiagn. + CVDRF	2017 BP	HBP diagnosis
Areas of origin (ref.: Native-born)								
East Europe	0.003	0.015	0.026*	−0.048**	0.013**	0.034***	0.048**	−0.004
	(0.003)	(0.009)	(0.012)	(0.013)	(0.004)	(0.010)	(0.015)	(0.015)
Africa	−0.018***	−0.016	−0.019	−0.053***	−0.028***	−0.038***	−0.059***	−0.073***
	(0.004)	(0.009)	(0.016)	(0.013)	(0.004)	(0.007)	(0.014)	(0.013)
Latin America	−0.019***	−0.027***	−0.059***	−0.091***	−0.017***	−0.022***	−0.033***	−0.049***
	(0.002)	(0.003)	(0.008)	(0.010)	(0.003)	(0.004)	(0.007)	(0.008)
Other Europe	−0.014***	−0.019*	−0.021	−0.055***	−0.008***	−0.002	−0.014	−0.029***
	(0.003)	(0.008)	(0.014)	(0.013)	(0.002)	(0.005)	(0.008)	(0.008)
Asia	0.026*	0.052*	0.024	−0.032	−0.009	−0.013	−0.026	−0.044*
	(0.010)	(0.021)	(0.038)	(0.029)	(0.005)	(0.013)	(0.025)	(0.022)
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
Comorbidities	✓	✓	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓	✓	✓
2017 BP Categories			✓				✓	
Adjusted R2	0.084	0.078	0.194	0.094	0.086	0.098	0.204	0.115
Clusters	27	27	27	27	112	112	112	112
Observations	230,459	89,052	71,090	86,618	540,018	212,998	211,309	234,123

All models include individuals aged 39-75. The analysis is stratified by regions, comparing estimates for the Madrid region to those of the rest of Spain. For both parts of Spain, we report results across the three subsamples defined by levels of need (as in the main analysis). Columns (1)-(4) report results for the Madrid region. Columns (5)-(8) report results for the rest of Spain. Columns (1) and (5) report results for individuals not diagnosed with hypertension or having blood pressure in the normal-range, as well as not treated with antihypertensive drugs in 2017. Columns (2) and (6) restrict the subsample of Column (1) and (5) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, diabetes, hyperlipidemia, and obesity. Columns (3) and (7) add to the specification the following blood pressure categories: normal ($SBP < 120$ mmHg, $DBP < 80$ mmHg), elevated (SBP : 120−129 mmHg, $DBP < 80$ mmHg), hypertension stage 1 (SBP : 130−139 mmHg, DBP : 80−89 mmHg), hypertension stage 2 ($SBP \geq 140$ mmHg, $DBP \geq 90$ mmHg). The hypertension categories used in Column (3) and (7) are from 2017 (previous year). Columns (4) and (8) report results for the subsample of patients with an active diagnosis of hypertension or with the systolic blood pressure above 130 mmHg and the diastolic above 90mmHg in 2018. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.24
Probability of having blood pressure measured across different subsamples, by region.
Source: Authors' own analysis based on the BDCAP administrative dataset, provided by the Spanish Ministry of Health.

Blood pressure	Madrid region			Rest of Spain		
	All sample	Undiagn. in 2017	Undiagn. + CVDRF	All sample	Undiagn. in 2017	Undiagn. + CVDRF
Areas of origin (ref.: Native-born)						
East Europe	0.004	0.009	0.007	−0.014	−0.005	−0.014
	(0.007)	(0.005)	(0.014)	(0.008)	(0.008)	(0.012)
Africa	0.027***	0.031***	0.064***	0.007	0.012*	0.030**
	(0.006)	(0.006)	(0.015)	(0.005)	(0.005)	(0.010)
Latin America	−0.007	0.003	0.010	−0.023***	−0.013***	−0.021**
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.007)
Other Europe	−0.028***	−0.021***	−0.029**	−0.057***	−0.041***	−0.069***
	(0.004)	(0.004)	(0.008)	(0.008)	(0.006)	(0.012)
Asia	0.021	0.032*	0.028	−0.005	0.003	0.010
	(0.014)	(0.013)	(0.025)	(0.010)	(0.009)	(0.018)
Demographics	✓	✓	✓	✓	✓	✓
Unrelated multimorbities	✓	✓	✓	✓	✓	✓
SES factors	✓	✓	✓	✓	✓	✓
PCC FE	✓	✓	✓	✓	✓	✓
Adjusted R2	0.150	0.107	0.105	0.182	0.142	0.151
Clusters	27	27	27	112	112	112
Observations	293,277	230,459	138,405	693,037	540,018	329,114

All models include individuals aged 39-75. The analysis is stratified by regions, comparing estimates for the Madrid region to those of the rest of Spain. For both parts of Spain, we report results across the three subsamples defined by levels of need (as in the main analysis). Columns (1)-(3) report results for the Madrid region. Columns (4)-(6) report results for the rest of Spain. Columns (1) and (4) include all individuals in the sample. Columns (2) and (5) report results for individuals not diagnosed with hypertension or having blood pressure in the normal-range, as well as not treated with antihypertensive drugs in 2017. Columns (3) and (6) restrict the subsample of Column (2) and (5) to individuals with at least one of the following CVD risk factor recorded in 2017: smoking, diabetes, hyperlipidemia, and obesity. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Data availability

The authors do not have permission to share data.

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