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The MIGHTY project (P2022ASXKR): demographic and health status profiles among migrants and non-migrants in a region of central Italy between 2011-2023 using Healthcare Utilization Databases

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SUMMARY

Background: Accurate identification of migrants using Healthcare Utilization Databases (HUDs) remains challenging, as citizenship and place of birth may classify residents differently. This study compared two migrant identification criteria and assessed their impact on demographic and health status estimates in an Italian region.
Methods: A population-based observational study was conducted in the Marche Region (Central Italy), including all residents between 2011 and 2023. The HUDs used were the Regional Beneficiaries Database (RBD), the Hospital Discharge Records, and the Drug Prescriptions Database. Migrants were classified using RBD's country of birth (RBD birth criterion) and citizenship (RBD citizenship criterion), distinguishing Italians (Ita-Marche), migrants from High Migratory Pressure Countries (HMPC), and from Highly Developed Countries. Agreement between criteria was assessed using Cohen's k. Health status was evaluated in residents aged ≥50 years using the Multisource Comorbidity Score (MCS).
Results: Using RBD birth criterion, 88.6% of residents were classified as Ita-Marche, 10.0% as HMPC, and 1.4% as HDC; using RBD citizenship criterion, these proportions shifted to 92.1%, 7.6%, and 0.3%, respectively. Agreement was moderate (k between 0.67-0.70). HMPC residents were notably younger and showed a more favourable health profile: 67% had MCS equal to 0 vs 45% among Ita-Marche, while multimorbidity (MCS ≥5) was lower (9% vs 21.5%). Similar patterns emerged using both criteria.
Conclusion: HUDs are a reliable source of secondary data that has long been used in the healthcare sector. Their use in epidemiological studies allows for up-to-date and detailed overview of the demographic structure and comorbidity profiles of healthcare beneficiaries according to their country of origin. The study showed that the two criteria for identifying migrants lead to variations in demographic estimates and health indicators, which should be carefully considered by decision-makers when planning targeted health services and allocating resources according to population needs.

Keywords: Migrants; Demography; Health Status; Administrative Databases; Italy

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INTRODUCTION

One of the key goals of the 2030 Agenda for Sustainable Development is to ensure good health and well-being for all individuals, promoting equitable access to healthcare services. In Italy, this principle is embodied by the National Health Service (*Servizio Sanitario Nazionale*, SSN), which guarantees access to Essential Levels of Assistance (*Livelli Essenziali di Assistenza*, LEA). These LEA include a range of healthcare services and benefits provided universally, either free of charge or upon payment of a small participation fee (ticket), aiming to reduce disparities and uphold the right to health for all residents [1].

In 2023, more than five million foreign residents live in Italy, with the majority (85%) concentrated in the central and northern regions. These individuals primarily originate from countries with high migratory pressure, such as Morocco, Albania, China, Ukraine, India, Bangladesh, and Egypt[2]. The scientific literature highlights significant challenges faced by the foreign population in accessing healthcare services, often linked to language barriers, limited health literacy, and insufficient knowledge of the healthcare system's organization[3]. Within this context, understanding the demographic, health and healthcare access profiles of migrants is the first step for planning targeted organizational and policy responses.

Electronic health databases provide valuable resources for this purpose, as they systematically collect comprehensive data on healthcare services, including hospitalizations, drug prescriptions, and outpatient care. These databases are a useful source of data for epidemiological studies and can be used for a variety of population-based study objectives[4].

Nevertheless, the identification of migrants within electronic health databases remains a methodological challenge in Italy. The most readily available criterion, citizenship, represents the closest approximation to the concept of foreigner or immigrant, but it is not consistently available across administrative databases, and when present, its quality varies across data sources and regions, leading to inconsistencies in classification [5]. An alternative criterion is the country of birth, which remains constant over time and is uniquely defined. However, this approach has limitations: on one hand, it may be too broad, as it includes Italian citizens born abroad; on the other hand, it may be too narrow, as it excludes the descendants of immigrants, the so-called "second generation" foreigners, who do not have Italian citizenship even though they were born in Italy and may still face barriers in accessing healthcare [5]. These two criteria produce a different quantification and demographic distribution of the migrant population. Understanding the methodological implications of selecting one criterion over the other, e.g. in terms of misclassification bias, is essential for epidemiological analyses and for informing health promotion strategies and healthcare planning aimed at reducing potential inequalities.

To address these questions, this study was conducted within the framework of the PRIN PNRR 2022 project MIGrants' HealTh and healthcare access in ItalY (MIGHTY, Prot. P2022ASXKR) and provides a systematic comparison between these two migrant identification criteria in a large, unselected population using regional longitudinal datasets. The MIGHTY project aims to quantify and assess healthcare utilization among the migrant populations using healthcare administrative databases, as well as to evaluate their health conditions in real-world settings and compare them with those of the Italian population. Specifically, this paper focuses on comparing two criteria for identifying migrants and their effect on the evaluation of demographic and health status profiles among migrants and Italians resident in Marche Region, between 2011 and 2023 using Healthcare Utilization Databases.

METHODS

Study design and data sources

A population-based observational study was conducted, including all individuals with healthcare coverage in Marche Region, a central Italian region with approximately 1.5 million inhabitants.

The study was based on healthcare utilization databases of the Marche Region, specifically: Regional Beneficiaries Database (RBD) for information on residents, including a unique anonymous identification code, date and place of birth, sex, nationality, date of death, and healthcare coverage start and end dates; Hospital Discharge Records (HDR) containing demographics recorded at the time of hospitalization, and details on hospital admissions and discharges, primary and up to five secondary diagnoses, as well as up to six procedures coded according to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM); Drug Prescriptions Database, which contains drug prescriptions coded according to the Anatomical Therapeutic Chemical (ATC) classification system reimbursed by the Nation Health Service, the date of dispensation, the Italian unique identifier of the pharmaceutical package, and the quantity dispensed.

All databases were linked using a deterministic record linkage procedure based on the beneficiary's unique anonymous identification code.

Reference population

The reference population was identified annually from 01/01/2011 to 31/12/2023 based on the subject's presence in the RBD and was defined using two criteria (Figure 1):

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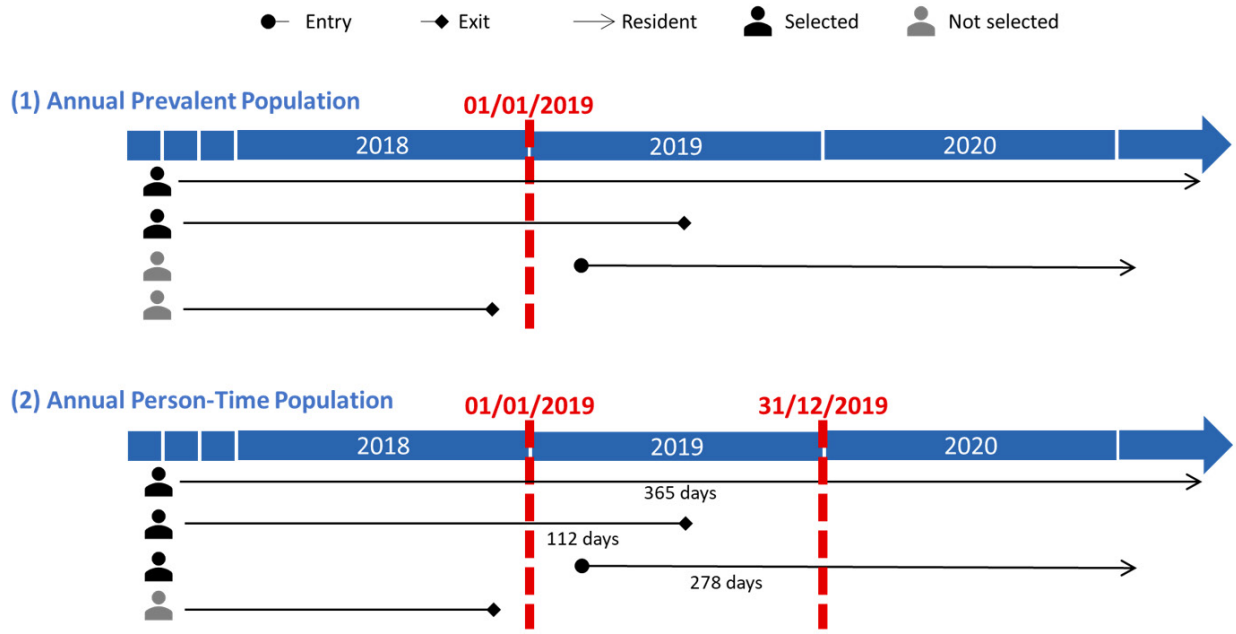
Figure 1. Annual reference population from 2011 to 2023 based on the (1) Annual Prevalent Population and (2) Annual Person-Time Population criteria. Entry may occur by birth or moving to Marche Region; Exit may occur by death or moving to another region/country



1) **Annual Prevalent Population**: Subjects who, as of January 1st of the year of analysis (1/1/20XX, from 2011 to 2023), had a recorded start date of healthcare coverage before January 1st of the reference year (1/1/20XX) and an end date of healthcare coverage (due to moving to another region/country) occurring after January 1st of the reference year and no recorded date of death before January 1st of the reference year (i.e., either missing or occurring after this date).
2) **Annual Person-Time Population**: Subjects who, at any time between January 1st and December 31st of the year of analysis (1/1/20XX – 31/12/20XX, from 2011 to 2023), had a recorded start date of healthcare coverage before December 31st of the reference year and an end date of healthcare coverage (due to moving to another region/country) occurring after January 1st of the reference year and no recorded date of death before January 1st of the reference year (i.e., either missing or occurring after this date). For this second group, the observation time was computed in terms of person-years (py) for each calendar year.

Definition of population groups

Two criteria were used to classify residents as Italians or Migrants.

The first was based on the place of birth recorded in the RBD (**RBD birth criterion**). The quality of this field, along with other demographic variables, is periodically controlled and monitored by the Region through consistency checks with the Italian tax code in RBD, a sixteen-character alphanumeric expression. The first six characters encode the surname and first name, the next five encode date of birth and sex, the sixteenth is a control letter, and positions 12 to 15 indicate the place of birth, corresponding to the Italian municipality or foreign country. For individuals born abroad, position twelve contains the letter 'Z' followed by a three-digit country code.

On the bases of RBD birth criterion, three population groups were defined:

- Ita-Marche: Individuals born in an Italian municipality.
- HMPC: Individuals born in a High Migratory Pressure Countries.
- HDC: Individuals born in a Highly Developed Countries.

The second criterion was based on the nationality field in RBD (**RBD citizenship criterion**) by which the name of the country of citizenship was used to classify residents in the same three population groups.

The classification of countries and the assignment of subjects to one of the three population groups followed the definition suggested by Trappolini and colleagues [6] and is detailed in Supplementary Table S1.

Statistical analysis

To describe the demographic profile of the three populations, age-sex pyramids from 2011 to 2023 were performed using the Annual Person-Time Population according to the RBD birth and citizenship criteria.

The Cohen's Kappa with confidence interval at 95% (CI 95%) was used to measure agreement between the RBD birth and citizenship criteria, applied to the Annual Person-Time Population.

To evaluate the health status profile, the Multisource Comorbidity Score (MCS) [7] was calculated for individuals aged 50 years or older within the Annual Prevalent Population from 2013 to 2023. Briefly, the MCS evaluates an individual's overall health status by identifying comorbid conditions based on data from the Hospital Discharge Records and the Drug Prescription Databases in the two years preceding January 1st of each reference year (1/1/20XX). A weight is assigned to each condition according to its association with one-year mortality, and the total MCS is obtained by summing these weights. The final score was categorized as 0, 1-4, 5-9, 10-14, 15-19, and 20 or more, with higher classes indicating poorer health conditions. The MCS has been validated at the national level as a predictor of mortality and healthcare utilization; however, because it is based on hospital discharge diagnoses and reimbursed drug prescriptions, it may not capture conditions managed exclusively in outpatient settings or not requiring pharmacological treatment.

Variables were summarised as absolute and percentage values. All statistical analyses were conducted using R.

RESULTS

During the period 2011-2023, based on the Annual Prevalent Population, the three population groups were distributed as follows: an average 88.60% of individuals were classified as Ita-Marche, 9.95% as HMPC, and 1.45% as HDC, according to RBD birth criterion (Table 1). When applying the RBD citizenship criterion, the distribution shifted to 92.11% Ita-Marche, 7.57% HMPC, and 0.32% HDC. A similar distribution was observed when considering the Annual Person-Time Population, with minor variations across population groups.

The concordance between RBD birth and citizenship criteria, when applied to the Annual Person-Time Population, ranging from a minimum Cohen's Kappa of 66.77% (95% CI: 66.54%-66.99%) in 2011 to a maximum of 70.23% (95% CI: 70.05%-70.41%) in 2023. Table 2 reports an example of this concordance for the year 2019, for which Cohen's Kappa was 69.03% (95% CI: 68.84%-69.23%). Overall, most of individuals classified as Ita-Marche based on RBD birth criterion (87.10%) were also categorized as Ita-Marche according to RBD citizenship criterion. Discrepancies emerged, with 3.42% of individuals categorized as HMPC by RBD birth criterion being classified as Ita-Marche by RBD citizenship criterion, and 1.14% of those identified as HDC by RBD birth criterion being classified as Ita-Marche under RBD citizenship criterion. Notably, the highest frequency of Italian citizenship was observed among individuals born in Argentina, Northern Macedonia, Albania, and Morocco (83.09%, 40.43%, 38.92%, and 37.39%, respectively, data not shown).

Table 1. Average annual population between 2011-2023 according to population groups (Birth vs RBD citizenship criteria) and to reference population (Annual Prevalent Population vs Annual Person-Time Population)

	Annual Prevalent Population (n, %)	Annual Person-Time Population (py, %)
RBD birth criterion		
Ita-Marche	1,345,300 (88.60%)	1,346,919 (88.52%)
HMPC	151,120 (9.95%)	152,628 (10.03%)
HDC	21,932 (1.45%)	22,103 (1.45%)
RBD citizenship criterion		
Ita-Marche	1,398,604 (92.11%)	1,400,267 (92.02%)
HMPC	114,891 (7.57%)	116,408 (7.65%)
HDC	4,857 (0.32%)	4,974 (0.33%)

py: person-year; Ita-Marche: Italian residents in Marche Region; HMPC: migrants from High Migratory Pressure Countries residents in Marche Region; HDC: migrants from Highly Developed Countries residents in Marche Region; RBD: Regional Beneficiaries Database.

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Table 2. Frequency distribution of Annual Person-Time Population in 2019 according to birth and RBD citizenship criteria

RBD birth criterion	RBD citizenship criterion			Total
	Ita-Marche	*HMPC*	*HDC*	
Ita-Marche	**1,331,313 (87.10%)**	16,461 (1.08%)	173 (0.01%)	1,347,947 (88.19%)
HMPC	52,202 (3.42%)	**105,658 (6.91%)**	291 (0.02%)	158,151 (10.35%)
HDC	17,396 (1.14%)	280 (0.02%)	**4,718 (0.31%)**	22,394 (1.47%)
Total	1,400,911 (91.65%)	122,399 (8.01%)	5,181 (0.34%)	1,528,491 (100%)

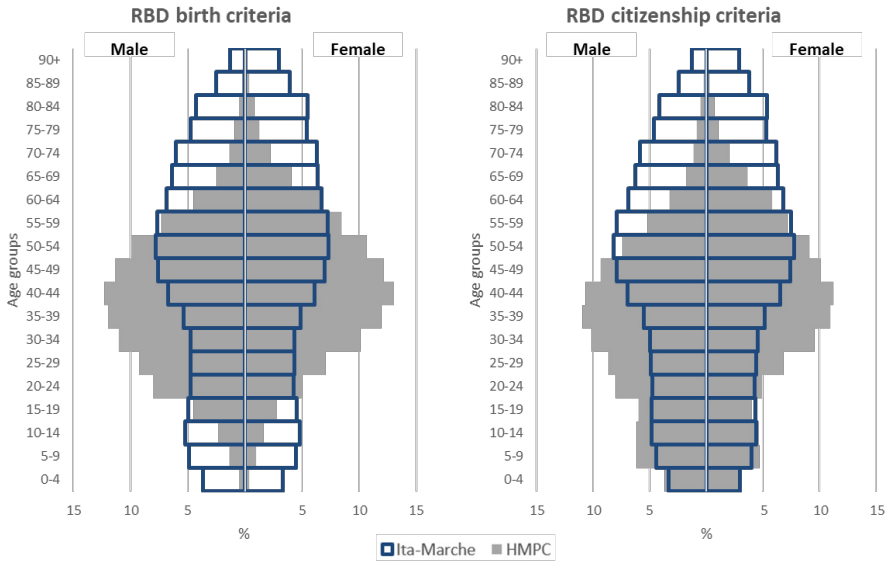
Ita-Marche: Italian residents in Marche Region; HMPC: migrants from High Migratory Pressure Countries residents in Marche Region; HDC: migrants from Highly Developed Countries residents in Marche Region; RBD: Regional Beneficiaries Database.

Demographic profile

The RBD birth and citizenship criteria yielded distinct demographic profiles when analysing age-sex pyramids from 2011 to 2023. All annual age-sex pyramids of the Ita-Marche, HMPC and HDC population groups are shown in the Supplementary Material Figure S1 and S2, to show changes over time. Figure 2 shows, as an example, the age-sex pyramids for the Ita-Marche and HMPC population groups, based on RBD birth and citizenship criteria, in 2019. The Ita-Marche group exhibited a classic stationary population pyramid, characterized by a wider middle section, indicative of an aging population with a relatively balanced distribution across age groups. In contrast, the HMPC group displayed a distinctly younger demographic profile, with a marked concentration of individuals in the working-age brackets (20-54 years), particularly among males, and a sharp narrowing at older ages. When comparing the two classification criteria, the RBD birth criterion identified a smaller proportion of individuals aged 0-14 years, while the RBD citizenship criterion produced a broader pyramid base and a less pronounced working-age predominance.

The HDC group consisted of a few thousand individuals, mainly concentrated in the 35-39 and 50-54 age groups, but according to the RBD citizenship criterion, the dispersion of the age distribution was greater (Supplementary Material Figure S1-S2).

Figure 2. Age-sex pyramids for the Ita-Marche (Italian residents) and HMPC (residents from High Migratory Pressure Countries) population groups based on RBD birth and citizenship criteria in 2019



Ita-Marche: Italian residents in Marche Region; HMPC: migrants from High Migratory Pressure Countries residents in Marche Region; HDC: migrants from Highly Developed Countries residents in Marche Region; RBD: Regional Beneficiaries Database.

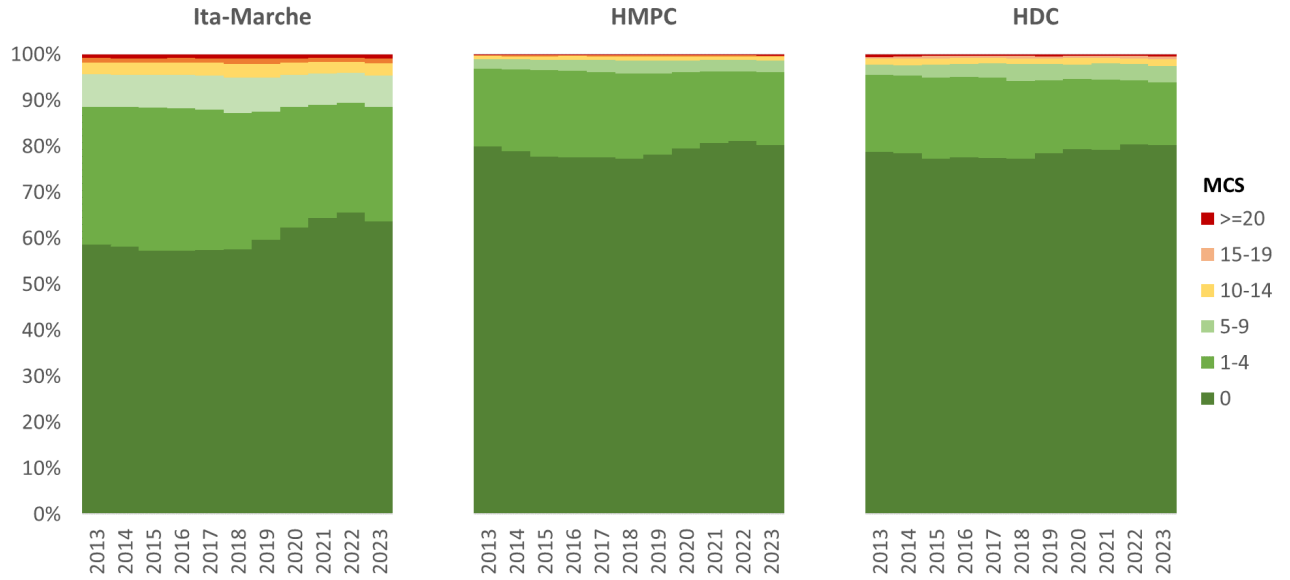
Health status profile

RBD birth and citizenship criteria highlighted comparable health status profiles for each population group. Overall, the health status in subjects aged 50 years or older, as measured by the Multisource Comorbidity Score (MCS), was better among individuals in the HMPC group than among those in the Ita-Marche group throughout the study period (Supplementary Materials Table S2). HDC had a health status profile more similar to the HMPC group than to the Ita-Marche group. However, the HDC group showed substantial differences in the distribution of MCS classes, in particular among 0 and 1-4 classes, when comparing RBD birth and citizenship criteria.

According to RBD citizenship criterion, individuals with an MCS of 0, indicating no condition traced in HDR or drug prescription databases, were on average 78,97% in the HMPC group and 60.13% in the Ita-Marche group, between 2013 and 2023 (Figure 3). The percentage of individuals with an MCS of 1-4 was consistently higher in the Ita-Marche group (ranging from 24.72% to 31.17%) compared to the HMPC group (15.12% to 18.88%); the proportion of individuals with an MCS of 5 or higher (5-9, 10-14, 15-19, and ≥20) was markedly greater in Ita-Marche (11.65%) than those observed in the HMPC group (3.76%).

The most frequent conditions, identified by MCS, varied across the populations (Supplementary Table S3): "Pain and inflammation" was the first most common condition in HMPC (36.99%) and the second most common in Ita-Marche (43.11%), while "Hypertension" was the second most common condition in HMPC (27.37%) and the first most common in Ita-Marche (44.88%); in both groups, the third most common condition was "Hyperlipidaemia" (16.28% HMPC vs. 29.28% Ita-Marche). Moreover, Ita-Marche group showed higher proportion in Coronary and peripheral vascular disease (18.18% vs 7.48%), Heart failure (14.72% vs 6.90%), Chronic pulmonary diseases (15.05% vs 6.57%), Gout (11.87% vs 3.72%) than HMPC group. It is worth noting the lower prevalence of these conditions among HMPC compared to Ita-Marche. Among the four age classes (50-59, 60-69, 70-79, and 80+) the HMPC health profile was consistently better than the one of the Ita-Marche. In 2023, proportion of individuals with no recorded comorbidities (MCS = 0) was constantly higher in HMPC compared to Ita-Marche, especially among older age groups (80+: 51.91% vs. 22.72%; 70–79: 57.33% vs. 36.85%, respectively). Conversely, Ita-Marche had a higher prevalence of multimorbidity, with more individuals classified in the 5–9 and 10–14 MCS categories (Supplementary Figure S3).

Figure 3. Health status profile calculated with Multisource Comorbidity Score (MCS) between Ita-Marche, HMDC and HDC population group, considering the RBD citizenship criterion



Ita-Marche: Italian residents in Marche Region; HMPC: migrants from High Migratory Pressure Countries residents in Marche Region; HDC: migrants from Highly Developed Countries residents in Marche Region; RBD: Regional Beneficiaries Database; MCS: Multisource Comorbidity Score.

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DISCUSSION

This is the first population-based study aimed at comparing different criteria for identifying residents based on their migrant status and assessing the effects of these criteria on demographic and health profiles, using healthcare utilization databases. Two approaches were proposed for the identification of migrants within the Healthcare Utilisation Databases: one based on place of birth and one from the citizenship fields in the RBD.

The criteria used in this study highlight crucial differences in the identification of migrants, as demonstrated by the moderate concordance observed by Cohen's Kappa values. The criterion based on citizenship shows a broader base of the sex-age pyramid in HMPC population and, therefore, has a greater capacity to identify second-generation migrants compared to the criterion of place of birth [8]. In working age groups, the differences between the two criteria can be considered negligible, although after 35 years the shape of the pyramid diverges slightly, likely reflecting longer residence in Italy and citizenship acquisition among migrants. Indeed, more than 40% of citizenship acquisitions in Italy occur among individuals aged ≥35 years [9,10].

On the other hand, people who obtain Italian citizenship as adults often maintain the cultural background and lifestyle of their country of origin [11,12]. Consequently, the choice of one criterion over another is linked to the objective of the study and the definition of the target population.

The three population groups showed distinct demographic structures, regardless of the identification criteria, as evidenced by the age-sex pyramids overtime. As expected, the Ita-Marche group exhibited an aging population with a balanced distribution across age groups, whereas the HMPC group showed a younger demography, characterized by a predominance of working-age individuals (20-54 years) and a narrower representation of the older age groups [13,14].

The low percentage of older age groups among HMPCs is partly due to the fact that migration is typical of young people seeking work [15] and partly to the well-known demographic phenomenon known as the "salmon effect," whereby older migrants return to their country of origin [16].

The different age distribution between HMPC and Ita-Marche groups persists even among individuals aged 50 years and older and may partially explain the different health profiles observed in the two populations. Indeed, the analysis of health status using the Multisource Comorbidity Score revealed a better health profile among the HMPC and HDC groups compared to the Ita-Marche group, particularly in older age classes. This "healthy migrant effect", widely documented in the scientific literature, reflects the selective migration processes, where younger and healthier individuals are more likely to migrate [17–19]. Furthermore, according to Campostrini et al [20], migrants in Italy generally exhibit better health behaviours and attitudes compared to the native population, including lower rates of smoking, alcohol consumption, and obesity; in a comparative study of European surveys, it was also observed that, after controlling for socioeconomic status, migrants self-reported better health than natives in Italy [18]. However, in our study we observed a high proportion of pain and inflammation conditions in the HMPC group, pointing out potential unmet healthcare needs, especially in the management of acute conditions and pain.

In the Marche region, the percentage of foreign residents in 2024 was 8.90%, lower than in most regions of northern and central Italy, but perfectly in line with the Italian average (8.91%) [13]. The proportion of migrants has risen steadily from 3% in 2002 to 10% in 2015, remaining at around 9% to date. This trend shows that migrants are not anymore, a marginal quota of regional population, therefore demographic, social, economic as well as health status profiles should be taken into account health policy considerations and health service planning.

This study has several strengths, foremost among them is its population-based design. The use of healthcare utilisation databases allowed to cover the entire population of an Italian region over a long observation period. The completeness and reliability of these secondary data sources has been amply demonstrated by their use in epidemiological studies for more than a decade. Consequently, the results obtained in comparing the two criteria for identifying the populations of interest can be considered valid and reproducible at national level. Moreover, the results of this study provided up-to-date and detailed information on the demographics and health status of resident migrants from countries with high migration pressure or highly developed countries, information not available through official national statistics alone. Since health data is routinely recorded in healthcare utilization databases throughout Italy, the same methodological approach can be repeated over time for regular monitoring and applied to other Italian regions. Certain limitations must also be acknowledged. Health status was assessed using the MCS, which relies on information from hospital admissions and reimbursed pharmaceutical prescriptions only. As a result, conditions that do not require hospitalisation or pharmacological treatment provided by the Regional Health Service are not traceable. Nevertheless, it should be considered that this comorbidity index is validated at national level. Finally, migrants from high migratory pressure countries may underutilize healthcare services, due to cultural and linguistic barriers, and limited health literacy, which could lead to under-ascertainment of some health conditions in this population.

In conclusion, this study showed a detailed overview of the demographic profiles and health

status of residents in the Marche region based on their country of origin. Furthermore, this population-based study provides useful information on the criteria for identifying migrants based on their country of origin and their impact on demographic and epidemiological assessments in real-world. Accurate identification method of migrant populations, when using HUDs, is essential not only for valid research but also for assessing and monitoring access to care in order to reduce and prevent possible disparities of this segment of the resident population.

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Polytechnic University of Marche: Rosaria Gesuita, Flavia Carle, Edlira Skrami, Andrea Faragalli, Marica Iommi, Silvana Antonietta Romio

AUTHORS' CONTRIBUTIONS

RG and MI conceptualized the study, developed the methodology for data analysis and drafted the manuscript. MI managed the data and performed the formal statistical analyses. MP and FC were in charge for data extraction and authorized their utilization. RG, MI, AF, ES assisted in the results interpretation. All authors assisted in manuscript revision, read and approved the final manuscript. RG is the guarantor of the overall content of the work.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

DATA AVAILABILITY STATEMENT

Restrictions apply to the availability of these data. The datasets generated and/or analysed during the current study are property of a third party that is the Regional Health Agency of Marche (ARSMarche) and, although they are anonymized, datasets are not publicly available due to the current regulation on privacy. The description of the administrative databases is available from the website ARSMarche/Flussi.

Other researchers can obtain access to the data through a formal request based on a research project to the Regional Health Agency of Marche.

ETHICS STATEMENT

This observational study fulfils the Italian regulations of ethics committees, which require only standard written informed consent at the time of hospital admission.

Ethical review and approval were waived for this study. We did not mention ethical safeguards simply because not pertinent in our study. All data were anonymized and managed in a manner that protected the privacy and confidentiality of individuals represented in the datasets.

According to Article 9 of the General Data Protection Regulation (European Union Regulation 2016/679), pseudonymized administrative data can be used without specific written informed consent when patient information is collected for healthcare management, quality evaluation, and improvement. All procedures adhered to the 1964 Helsinki Declaration and its subsequent amendments.

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The Italian Ministry of University and Research had no role in the design of the study, the collection, the analysis, the interpretation of the data, or the decision to approve publication of the finished manuscript.

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