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Editors: Giovanna Boccuzzo, Enrico Bovo,
Marica Manisera, Luigi Salmaso

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**IES 2025 - Innovation & Society: Statistics
and Data Science for Evaluation and Quality**

BOOK OF SHORT PAPERS

Editors: Giovanna Boccuzzo, Enrico Bovo,
Marica Manisera, Luigi Salmaso

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June 25-27, 2025

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Inequalities in adherence to the diabetes guidelines in the migrant population at the regional level

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Inequalities in adherence to the diabetes guidelines in the migrant population at the regional level

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Abstract The present retrospective cohort study analyses adherence to diabetes management guidelines among Italian and foreign-born patients using regional health administrative data. The study includes individuals diagnosed with type 1 or type 2 diabetes in 2018 (ages 18–100) and evaluates adherence over a one-year follow-up using two process indicators: receipt of essential screenings and specialist visits. Only migrants from High Migration Pressure Countries (HMPCs) were analyzed. To ensure comparability, propensity score matching and inverse probability weighting were applied. Findings indicate that HMPC migrants were less likely than Italians to receive care or visit specialists, possibly due to socio-economic and linguistic barriers.

Keywords: Healthcare disparities, migrant health, diabetes management, adherence to guidelines.

1. Introduction

Disparities in healthcare access between migrant populations and local residents are well-documented in Italy [1, 2]. The health needs of migrants are influenced by a combination of cultural, religious, linguistic, and systemic factors, which can impact their interactions with healthcare services. These disparities are particularly pronounced in the management of diabetes, given the severe complications associated with poor disease control. In Italy, migrant diabetics tend to underuse screening, disease management services and adherence to treatment guidelines [3]. These differences are due to a number of factors, including socioeconomic conditions, demographic characteristics and potential barriers within regional healthcare systems. With these premises, this study¹ aims to evaluate the quality of diabetes care among adult migrants and non-migrants in Sicily by assessing their adherence to recommended monitoring guidelines over a one-year follow-up period. By examining key process indicators, it aims to determine whether migrants receive diabetes care in accordance with clinical recommendations.

2. Data and Methods

This retrospective cohort study used administrative data from the Regional Healthcare Beneficiaries Database, including individuals, aged 18–100 residing in Sicily in 2018, diagnosed with type-1 or type-2 diabetes mellitus, as defined by CReG algorithms developed in the Lombardy region [4].

Two process indicators were utilised as proxies for adherence to recommended monitoring guidelines during a one-year-long follow-up period: i) At least one glycated hemoglobin

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(HbA1c) measurement and at least two of the following: lipid profile monitoring, microalbuminuria monitoring, or fundus examination (from here on out identified as "receipt of care"); ii) A follow-up visit at a diabetes care centre (from here on out, identified as "specialist visit"). Nationality was determined by country of birth, distinguishing Italian from foreign-born individuals. Only migrants originating from High Migration Pressure Countries (HMPCs) were considered, while those from Advanced Economies (AEs) were excluded. The analysis was expanded to encompass additional variables, including age, gender, and the number of chronic conditions, as defined according to the Chronic Related Groups (CReG).

To examine the effect of nationality on adherence to diabetes care process indicators while controlling for imbalances in patient characteristics between Italians and migrants, propensity score matching and inverse probability weighting are used. Over the past decade, propensity scores have become widely used to control pretreatment imbalances in non-randomized or observational studies investigating the causal effects of treatments or interventions. Propensity scores [5] are used to match, stratify, or weight samples from treatment and control groups, ensuring that observed pretreatment characteristics are comparable between the groups. This approach helps mitigate or eliminate confounding factors from the analysis. In health research, it has been extensively used to balance sample characteristics in comparative studies, such as assessing the impact of socioeconomic status on healthcare access [6], evaluating disparities in chronic disease management across different ethnic groups [7], and analysing the effect of insurance coverage on diabetes outcomes [8], among others.

In this study, Prognostic Score Matching (PGM) is used to create weights for Inverse Probability Weighting (IPW). With PGM, only highly correlated factors to the investigated outcome are included in the model [9]. This provides a simulated special blocked randomised trial, in which the "risk levels" constitute the blocks. The potential outcomes - i.e. adherence or not to receipt of care and specialist visits - are balanced within the blocks [9].

Let X_i be the set of covariates, A_i be the indicator of whether an individual was born in Italy or in a HMPC, and Y_i be the observed outcome (receipt of care or specialist visit) for unit $i = 1, \dots, n$. Let $Y_i(a)$ be the potential outcome had unit i been given the "treatment" a , i.e., $a = 1$ identifies who was born in a HMPC and $a = 0$ for those born in Italy. It is assumed that $\{X_i, A_i, T_i(0), Y_i(1)\}, i = 1, \dots, n$ are independent and identically distributed.

The prognostic score $\Psi(X)$ is defined as a balancing score so $Y(0) \perp\!\!\!\perp X \mid \Psi(X)$. Since $Y(0)$ follows a quasi-binomial model with $\mu_0(X) = X^T \beta_0$ and constant variance, $\Psi(X) = E(Y(0) \mid X) = X^T \beta_0$.

If there is no hidden bias [9]:

$$Y(0) \perp\!\!\!\perp A \mid \Psi(X)$$

i.e., by conditioning on the prognostic score, treatment ignorability holds.

Here, the prognostic score matching is pursued by estimating the average treatment effect (ATE) on the treated (ATT) and the treated were matched without replacement.

Thus, the propensity scores and the prognostic scores were computed using logistic regression models, in which the binary dependent variable describes whether the patient was

Italian or foreign-born and the independent variables are confounding factors such as: age, sex ("male" as baseline category), and number of chronic diseases.

All the analysis was produced using R version 4.4.2 [10], and its packages WeightIt version 1.3.2 [11] and cobalt version 4.5.5 [12].

3. Results

In 2018, in the cohort analysed, 64.09% of people who were born in Italy received diabetes care, compared to only 49.54% of people from HMPC. A similar trend is observed for specialist visits: 34.80% of people from HMPC consulted a specialist, compared to 44.43% of Italian patients.

Both propensity scores and prognostic scores were calculated to assess the impact of nationality on adherence to diabetes care process indicators while accounting for imbalances in patient characteristics between Italians and migrants. Figure 1 illustrates the distribution of prognostic scores for country of origin in both the unadjusted and adjusted samples. Similarly, Figure 2 shows the age distribution in the sample, both unweighted and weighted by prognostic score. In both cases, weighting by prognostic score makes the distributions by nationality more similar, although some imbalances remain as shown in Figure 2.

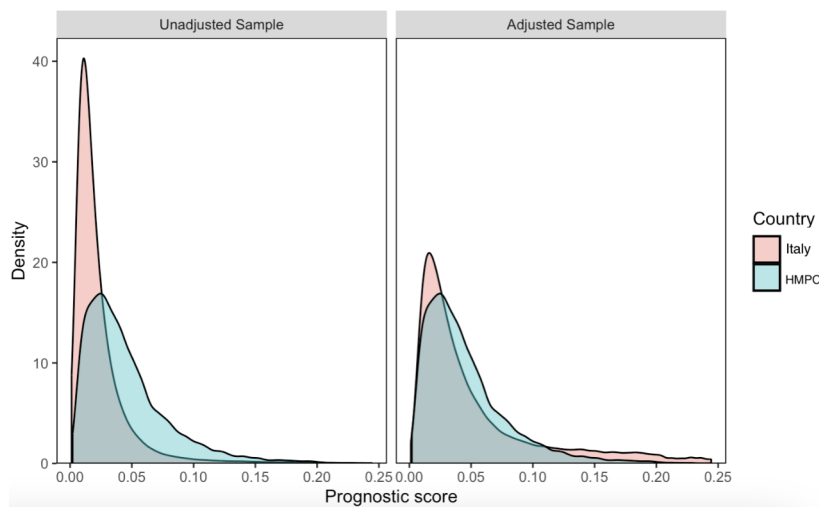


Figure 1: Prognostic score distribution in the adjusted and in the unadjusted samples

After computing the propensity and prognostic scores, a total of four models were estimated—two for each process indicator. Logistic regression models were applied to matched units obtained through propensity score matching (PSM), while inverse probability weighting (IPW) was used with prognostic scores to adjust for potential imbalances.

Since all available control variables were incorporated during the PSM and PGM process, the only covariate explicitly included in the final models was patient country of origin, with individuals from HMPC serving as the baseline reference group. The results, presented in Table 2, show the relationship between origin and adherence to diabetes care indicators, with odds ratios (OR) reported for ease of interpretability.

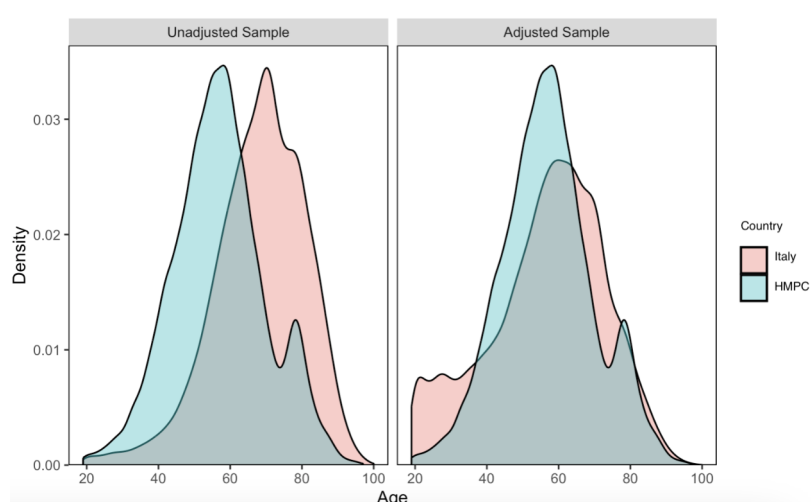


Figure 2: Age distribution - unweighted and weighted by prognostic scores

Italians are significantly more likely to receive care than migrants from HMPC, even after adjusting for imbalances in patient characteristics. Indeed, the odds ratio for Italians compared to individuals from HMPC is 1.499 in the logit model and 1.471 in the IPW model, both highly significant ($p < 0.001$). The intercept is not significant in the logit model but is highly significant in the IPW model ($p < 0.001$), suggesting potential differences in sampling or distribution adjustments.

As for specialist visits, the odds ratio for Italians is 1.501 in the logit model and 1.553 in the IPW model, again highly significant ($p < 0.001$). This confirms that Italians have a significantly higher likelihood of visiting a specialist compared to migrants from HMPC. The intercept is statistically significant ($p < 0.001$) in both models, indicating a structured pattern in the probabilities of specialist visits, even when nationality is not considered.

Table 1: Results of model estimation.

	Receipt of care		Specialist visit	
	logit	IPW	logit	IPW
(Intercept)	0.982 (0.404) [0.940; 1.025]	0.982*** (<0.001) [0.973; 0.991]	0.534*** (<0.001) [0.510; 0.558]	0.534*** (<0.001) [0.528; 0.539]
Italian (vs. HMPC origin)	1.499*** (<0.001) [1.409; 1.594]	1.471*** (<0.001) [1.452; 1.491]	1.501*** (<0.001) [1.410; 1.598]	1.553*** (<0.001) [1.532; 1.575]
Number in HMPC category	8,282	8,282	8,282	8,282
Number of Italians	8,282	334,704	8,282	334,704

Notes. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; p -values in round brackets and 95% confidence intervals in square brackets.

4. Conclusion

The aim of this work was to study adherence to diabetes management guidelines differences among Italian and foreign-born patients using administrative data retrieved from the regional health database. To achieve this goal, both PSM and PGM were used to assess the impact

of country of origin on adherence using logistic regression models and IPW.

The findings consistently indicate that Italians have a significantly higher likelihood of both receiving medical care and visiting specialists compared to migrants from HMPC, confirming previous findings [1, 2, 3]. These disparities persist after adjusting for potential confounders. The robustness of these results is reinforced by the strong statistical significance across all models. The observed differences suggest that structural, systemic, or socio-economic barriers may limit migrants' access to healthcare. Targeted policy interventions, such as culturally tailored programs and linguistic mediation, could improve healthcare access.

This study primarily focuses on data from Sicily; however, future research will aim to refine this analysis by comparing the results with those from other Italian regions. Expanding the geographical scope will allow for a more comprehensive understanding of potential regional disparities in healthcare access and utilization.

Despite its contributions to the topic, this study is not without limitations. One of the main concerns relates to the quality of administrative data, particularly the accuracy of coding within the information flows used. Additionally, the definition of disease based on indirect algorithms, such as CReG, introduces a potential risk of misclassification. For instance, there is no distinction between type-1 or type-2 diabetes. Moreover, the classification of individuals as either "Italian" or "from an HMPC" may not fully capture cases where Italian citizenship was acquired due to birth abroad to Italian parents or among second-generation migrants. These nuances could lead to an incorrect categorization of some individuals, potentially affecting the results.

Furthermore, the absence of data on migrants' length of stay in Italy—a key proxy for integration, language proficiency, and healthcare access—limits the ability to account for important differences within the foreign-born population. Similarly, the lack of information on individuals' legal status prevents a more comprehensive assessment of barriers to healthcare access, which may differ based on residency permits or documentation status.

Another important limitation is the absence of socio-economic data, which plays a crucial role in shaping healthcare utilization patterns. Incorporating indicators of socio-economic status would allow for better control of potential biases related to income, education, and employment, offering a more nuanced understanding of disparities in healthcare access between Italians and migrants.

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