Primary healthcare characteristics and variations in avoidable hospital admissions and emergency visits: an ecological study in Italy

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Running title

Primary healthcare characteristics and avoidable hospital utilization in Italy

Title

Variations in avoidable hospital admissions and emergency visits by primary care characteristics: an ecological study in Italy

Titolo

Variazioni nei ricoveri ospedalieri e nelle visite di emergenza evitabili in funzione delle caratteristiche delle cure primarie in Italia: uno studio ecologico

Keywords

Primary Healthcare; Healthcare outcomes; Inappropriate hospitalisation; emergency presentations

Parole chiave

Assistenza sanitaria primaria; Esiti sanitari; Ospedalizzazione inadeguata;

Abstract

Background: Primary healthcare plays a central role in providing preventive care, managing chronic conditions and reducing inappropriate emergency presentations. The study aimed at providing population-level evidence on the correlation between the characteristics of primary healthcare across Italian regions and health outcomes included in the National Programs Outcomes of the National Agency for Regional Healthcare Services.

Study Design: Ecological study

Methods: We analysed healthcare data from the National Agency for Regional Healthcare Services, the public lists of primary care doctors and the National Federation of Surgeons and Dentists and the National Institutes of Statistics referring to the 20 Italian regions. Pearson's correlation and Spearman's correlation were used to assess the relationships between primary healthcare characteristics and health outcomes.

Results: Overall, across all Italian regions each GP had on average 1447 and was 57.5 years old. The study found positive correlations between the number of patients per general practitioner and

non-urgent Emergency Department visits among adult patients (Pearson's r = 0.58, p = 0.008), the number of residents aged 65+ per general practitioner and the rate of chronic obstructive pulmonary disease admissions (Pearson's r = 0.49, p = 0.029), and the age of general practitioners and lower-extremity amputations in diabetes patients (Pearson's r = 0.56, p = 0.011). A negative correlation was observed between the age of general practitioners and urinary tract infection admissions (Pearson's r = -0.76; p < 0.001). A non-linear negative correlation was found between the age of general practitioners and chronic obstructive pulmonary disease admissions (Spearman's ρ = -0.46, p = 0.041).

Conclusions: The findings emphasise the importance of guaranteeing sufficient numbers of primary healthcare physicians to meet patients' needs, and for limiting avoidable hospitalizations and emergency presentations. GPs' age might also influence the provision of care, but more research is needed on possible mechanisms.

Riassunto

Sfondo: L'assistenza primaria è un componente cruciale dei sistemi sanitari, svolgendo un ruolo centrale nel fornire assistenza preventiva, gestire le condizioni croniche e ridurre le visite non urgenti al pronto soccorso. Questo studio ha lo scopo di indagare la correlazione tra le caratteristiche dei medici di medicina generale in Italia e gli indicatori sanitari riportati nel Piano Nazionale Esiti dell'Agenzia Nazionale per i Servizi Sanitari Regionali.

Disegno dello studio: Studio ecologico

Metodi: abbiamo analizzato i dati del Programma Nazionale Esiti, le liste pubbliche di medici di medicina generale e pediatri di libera scelta e i dati della Federazione Nazionale degli Ordini dei Medici Chirurghi e Odontoiatri riferiti alle 20 regioni italiane. Abbiamo utilizzato i coefficienti di correlazione di Pearson e di Spearman per valutare le correlazioni.

Risultati: complessivamente la media del numero di pazienti per medico di medicina generale era 1447 e l'età media dei medici era 57,5 anni. Lo studio ha trovato correlazioni positive tra il numero di pazienti per medico di base e il tasso di visite non urgenti al pronto soccorso tra gli adulti (r di Pearson = 0,58, p = 0,008), il numero di cittadini di età superiore ai 65 anni per medico di base e il tasso di ricoveri per broncopneumopatia cronica ostruttiva (r di Pearson = 0,49, p = 0,029) e l'età dei medici di base e il tasso di amputazioni agli arti inferiori tra i pazienti con diabete (r di Pearson = 0,56, p = 0,011). Al contrario, è stata osservata una correlazione inversa tra l'età dei medici di base e il tasso di ricoveri per infezioni del tratto urinario (r di Pearson =-0,76; p < 0,001). È stata trovata una correlazione non lineare inversa tra l'età dei medici di base e il tasso di ricoveri per BPCO (ρ di Spearman = -0,46, p = 0,041).

Conclusioni: Questi risultati sottolineano l'importanza di garantire un numero sufficiente di medici per le cure primarie per soddisfare i bisogni di salute e limitare ospedalizzazioni potenzialmente evitabili e accessi potenzialmente impropri al pronto soccorso. Anche l'età dei medici di famiglia potrebbe influenzare la fornitura di assistenza, ma sono necessarie ulteriori ricerche sui possibili meccanismi.

Introduction

Primary health care (PHC) is a whole-of-government and whole-of-society approach to health that combines three core components: multisectoral policy and action, empowered people and communities, and primary care and essential public health functions as the core of integrated health services (1,2). In Italy, PHC is provided by general practitioners (GPs) and primary care paediatricians (pediatri di libera scelta, PLSs). Primary care doctors are the first point of contact for patients, playing

a crucial role in providing appropriate healthcare assistance, preventative healthcare, reducing the number of inappropriate specialist visits, Emergency Department (ED) visits, etc. (3).

All citizens are registered with a primary care doctor and from the age of 6 to 14 years, they must switch from a PLS to a GP, with some exceptions (4). The current legislation and national collective contract of GPs and PLSs established 1500 and 880 as the maximum number of patients for each, while the optimal number is set to 1000 and 600, respectively (4–6). Some regional and local health authorities raised those limits to address the shortage of primary care doctors and guarantee primary care to the entire population (7).

There is limited research on the relationship between primary care organisation and health outcomes in Italy. The National Agency for Regional Healthcare Services (Agenzia Nazionale per i Servizi Sanitari Regionali, Agenas) annually releases the national report "Programma Nazionale Esiti (PNE)", analysing various healthcare indicators. One section focuses on primary care indicators, including non-urgent daytime emergency department visits and potentially avoidable hospital admissions (8,9). The aim of this ecological study was to analyse the correlation between the characteristics of primary care across Italian regions and PNE indicators.

Methods

We obtained the list of GPs and PLSs working in Italy from various regional and national health authorities' websites. We determined each doctor's age using data from the National Federation of Surgeons and Dentists (FNOMCeO) website. Due to varying website update schedules, we reported the data as available on each site (Supplementary Table 1). We used geographical and demographic data updated to 2022 from the National Institutes of Statistics (Istituto Nazionale di Statistica, ISTAT).

For each of the 20 Italian regions, we analysed the average age and the average number of residents assigned to each primary care doctor, the latter serving as an indirect measure of the number of registered patients per GP and PLS. This measure was calculated as the total number of residents in the region aged 14 years or older, and the total number of residents aged less than 14 years, respectively, divided by the number of GPs and PLSs in the region. For GPs, we also examined the number of patients aged 65 years or older and 75 years or older.

Finally, we investigated the correlation between such characteristics and several indicators from the PNE 2023 report (which is based on data from the year 2022). For GPs the indicators included are non-urgent ED visit rate of adult patients (≥14 years of age) during daytime (from 8 A.M. to 8 P.M.) from Monday to Friday (10), lower-extremity amputation among patients with diabetes rate (11), asthma among adults admission rate (12), chronic obstructive pulmonary disease (COPD) admission rate (13), diabetes short-term and long-term complication admission rate (14), uncontrolled diabetes (without complications) admission rate (15), urinary tract infection admission rate (16), influenza admission rate (17), hypertension admission rate (18) and heart failure admission rate. For PLSs, the indicators included are non-urgent daytime ED visit rate among children (19), asthma among children admission rate (20) and paediatric acute gastroenteritis admission rate (21). We used values adjusted for age and sex, calculated by Agenas as described in every indicator protocol, and we aggregated them considering the average value for each region.

The dataset was formed by 20 observations, one for each region, with the characteristics of the primary healthcare doctors and the PNE indicators analysed.

The correlation between primary care characteristics and PNE outcome indicators was evaluated with the Pearson correlation coefficient and the Spearman correlation coefficient. For linear correlations, linear regression models were fitted too.

P-values <0.05 were considered statistically significant. Analyses were conducted using Python v. 3.10.9 and the following libraries: pandas v. 1.5.3, scipy v. 1.10.1, statsmodels v. 0.13.5, matplotlib v. 3.7.1, seaborn v. 0.12.2. The library italy-geopop v. 0.6.2 was used to retrieve geographical and demographic data, as it includes data from 2022 from ISTAT.

Results

Overall, across all Italian regions each GP had on average 1447 patients (range: 1075-1879) and 400 patients over-65 years (range across regions: 302-497). GPs were 57.5 years old on average (range across regions: 51.6-67.1). Each PLS had 1139 patients on average (range: 837-1905) and was 58.9 years old (range across regions: 53.6-66.0). PNE indicators characteristics are reported in Tab. 1.

Table 1. PNE indicators description

	Mean (SD)	***Min-Max***
Non-urgent day time ED adults visit rate (%)	55.2 (17.3)	31.0 - 94.9
Lower-extremity amputation among patients with diabetes rate (x100,000)	7.6 (2.3)	4.8 - 12.8
Asthma among adults admission rate (x100,000)	3.2 (2.0)	1.0 - 8.0
COPD admission rate (x10,000)	13.4 (3.9)	7.7 - 20.8
Diabetes short-term and long-term complication admission rate (x100,000)	28.9 (8.7)	12.0 - 43.6
Uncontrolled diabetes (without complications) admission rate (x100,000)	6.8 (4.1)	0.0 - 17.0
Urinary tract infection admission rate (x100,000)	61.3 (39.3)	18.4 - 161.6
Influenza admission rate (x100,000)	6.2 (9.5)	0.5 - 41.5
Hypertension admission rate (100,000)	12.3 (5.3)	4.4 - 24.3
Heart failure admission rate (x10,000)	26.5 (4.8)	17.4 - 32.4
Non-urgent day time ED children visit rate (%)	77.2 (23.3)	42.7 - 126.6
Asthma among children admission rate (x10,000)	1.6 (0.9)	0.1 - 3.8
Paediatric acute gastroenteritis admission rate (x10,000)	4.9 (2.4)	1.4 - 10.6

PNE: programma nazionale esiti, ED: emergency department, COPD: chronic obstructive pulmonary disease, SD: standard deviation.

The study found a positive correlation between the number of patients per GP and the rate of non-urgent adult visits to emergency departments during the day (Pearson's $r = 0.58$, $p = 0.008$). Additionally, there was a positive correlation between the number of over-65 residents per GP and the rate of COPD admissions to hospitals (Pearson's $r = 0.49$, $p = 0.029$). Further, the study found a positive correlation between the age of GPs and the rate of lower-extremity amputations among patients with diabetes (Pearson's $r = 0.56$, $p = 0.011$). Conversely, a negative correlation was observed between the age of GPs and the rate of urinary tract infection admissions (Pearson's $r = -0.76$; $p < 0.001$). Among with those findings, we fitted the linear regression models (Figure 1).

The study also reported a non-linear negative correlation between the age of GPs and COPD admission rate (Spearman's $\rho = -0.46$, $p = 0.041$). No significant correlations were found between

the number of patients per PLS and any of the PNE indicators, nor between the age of PLSs and these indicators.

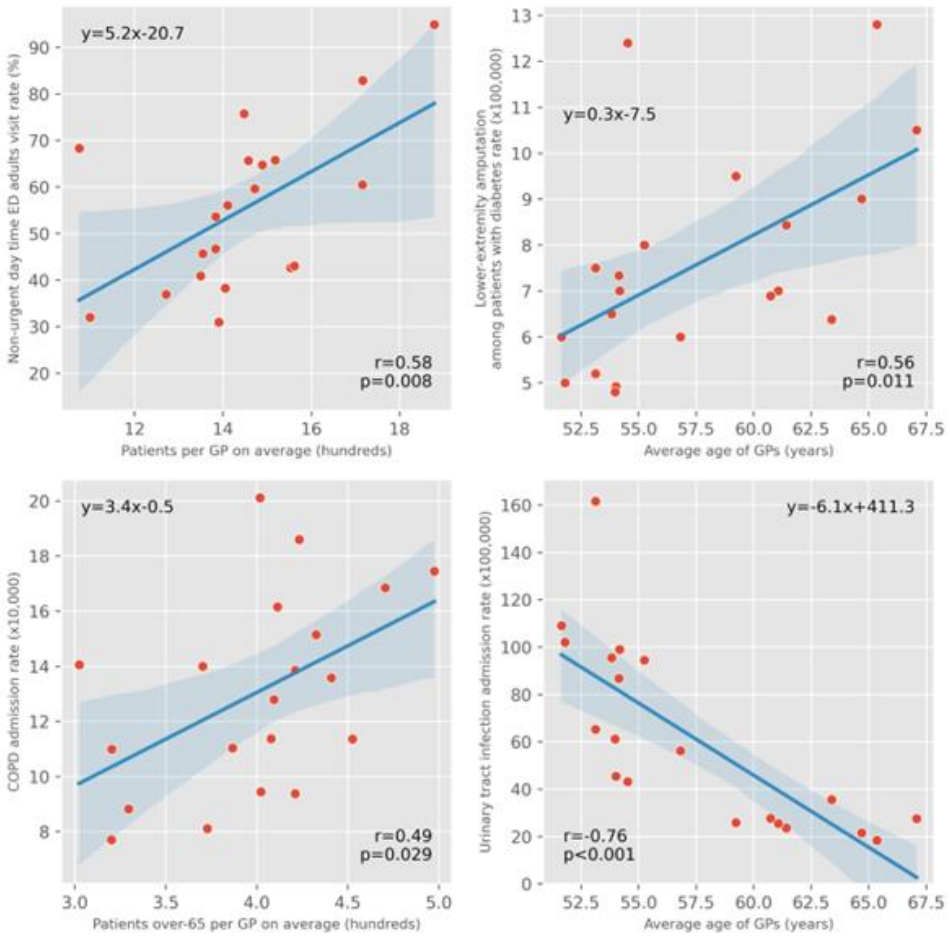

Figure 1: correlations between the characteristics of GPs and the PNE indicators with the equations representing the fitted models. ED: emergency department, GP: general practitioner, COPD: chronic obstructive pulmonary disease.

Discussion

Our study highlighted a positive correlation between the number of residents per GP and non-urgent ED visits, as well as between the number of over-65 residents per GP and COPD admission rate. Moreover, we found that age of GPs was positively correlated with lower-extremity amputation rates among patients with diabetes, while it was negatively correlated with urinary tract infection admissions.

A high number of patients per GP might lead to greater difficulties for patients in accessing primary healthcare with patients resorting for ED access. Previous Italian studies are scant, but a few studies reported a lower likelihood of ED visits for patients who have greater access to primary care medicine (22) and demonstrated that increasing primary care accessibility limited inappropriate ED use, estimating the magnitude of reduction to be 10% to 15% in inappropriate visits (23). This is also in line with available studies from countries with a Beveridge-type National Healthcare System. In England, 26.5% of ED visits probably were preceded by the impossibility for patients to obtain a visit with the GP within a reasonable time (24). General practices providing more timely access has been shown to be associated with fewer ED visits per registered patient, however the number of GPs/1000 patients was not independently associated with this outcome (25). In Sweden and Belgium the most common pathway for emergency presentation is self-referred walk-in and only a small percentage of ED visits were a referral from a general practitioner (26) (27). The main reason for non-urgent use of the ED might be that patients feel that it takes too long to wait for an appointment with their primary care doctor, even if they were successful in scheduling one (28). In contrast, other studies suggested that potentially avoidable ED visits were higher in deprived areas, while they were not correlated with access to primary care (29).

COPD is a major cause of hospital admissions worldwide, especially in elderly patients who are the group with the highest number of prevalent cases (30). Effective primary care, including patient education, regular monitory and therapeutic interventions can reduce COPD-related hospital admissions (31), but increasing number of older and complex patients per doctor might limit the possibilities of providing high quality care. Some previous studies have also suggested that rates of COPD admissions can be influenced by the prevalence of diagnosed COPD and socioeconomic status rather that other practice characteristics, such as practice performance scores (32).

The negative correlation between age of GPs and urinary tract infection admissions observed in our study may be explained by older GPs having more experience in treating such infections, with a higher success rate. In contrast, we found a positive correlation between age of GPs and lower-extremity amputation among patients with diabetes rate. While suboptimal management of diabetic patients might contribute to this finding, the underlying mechanisms are unclear. To the best of our knowledge no previous study investigated the effect of the age of doctors, nor the years of work experience. One study, described a negative correlation between years of work experience of GPs and the number of referrals to outpatient health services (33), while an alternative explanation could be that older physicians referred more because they saw older patients (34).

The findings of the present study should be considered in the context of several limitations. First, due to the ecological design we cannot establish causality, nor can we evaluate confounding factors. The sources we used to obtain the list of GPs and PLSs were not all up to date. Since we used Pearson's coefficient and Spearman's coefficient to assess the correlation, we might have missed other types of correlation (e.g. quadratic, etc.). Data from ISTAT let us calculate the number of residents per GP and PLS, <14 and ≥14 years respectively, based on the assumption that every resident, having the right to be assisted by a primary care doctor, is indeed registered with a doctor.

The number of residents per doctor is assumed to be a valid proxy indicator for the number of patients registered with a primary care doctor, but, as an aggregated average value, does not provide information about the variability. Moreover, primary care doctors can manually limit their number of patients before reaching the maximum number of patients. Agenas calculated non-urgent ED visits rate using white and green triage discharge colours as cases (10,19). The discharge triage colour is attributed evaluating the conditions at the moment of discharge, after the diagnostic and therapeutic process have been completed, while the admission triage code could differ, reflecting more precisely whether the ED visit was urgent or not. More studies and a punctual analysis conducted at GP-level could be useful to further explore the findings and shed light on underlying mechanisms.

Conclusions

This ecological study explored the correlation between the characteristics of primary care doctors in Italy and various healthcare outcomes. The findings suggest that a higher patient load per GP is associated with an increased rate of non-urgent ED visits. Additionally, a higher proportion of over-65 residents per GP is linked to a higher rate of COPD admissions. Moreover, the age of GPs exhibits a complex relationship with healthcare outcomes. The study findings underscore the importance of optimizing primary care delivery to improve patient outcomes. Increasing the number of GPs and improving accessibility to primary care services can contribute to reducing inappropriate ED utilization and associated costs. More research is needed to better understand the causal mechanisms underlying these associations and to develop targeted interventions.

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Supplementary Table 1. Date of updated of the lists of GPs and PLS provided by regions or national health trusts.

Region	Frequency of update, distribution method, date of the list used in the study (day/month/year)	
	GPs	**PLSs**
Piemonte	Continuous update, website, 23/05/2023	
Valle d'Aosta	Continuous update, website, 23/05/2023	
Lombardia	Continuous update, website, 23/05/2023	
Trentino-Alto Adige	Continuous update, website, 23/05/2023	
Veneto	Continuous update, website, 23/05/2023	
Friuli-Venezia Giulia	Continuous update, website, 23/05/2023	
Liguria	Continuous update, website, 23/05/2023	
Emilia-Romagna	Continuous update, website, 23/05/2023	
Toscana	Continuous update, website, 23/05/2023	
Umbria ASL Umbria 1 ASL Umbria 2 • District of Terni • District of Foligno • District of Spoleto • District of Narni e Amelia • District of Orvieto • District of Valnerina	 Continuous update, website, 23/05/2023 Periodic update, Excel tables 13/04/2023 23/05/2023 06/04/2023 02/05/2023 07/02/2023 03/04/2023	 Continuous update, website, 23/05/2023 Periodic update, Excel tables 26/01/2023 14/03/2023 24/02/2021 04/01/2023 17/01/2022 03/02/2023
Marche	Continuous update, website, 23/05/2023	
Lazio	Continuous update, website, 23/05/2023	
Abruzzo	Continuous update, website, 23/05/2023	

ASP: national health trust (Azienda Sanitaria Provinciale), ASL: national health trust (Azienda Sanitaria Locale), GP: general practitioner, PLS: primary care pediatrician (pediatra di libera scelta), 1: date of update deducted by the file name, 2: date of update not reported and not deductible.

Supplementary Table 1. Continued.

Region	Frequency of update, distribution method, date of the list used in the study (day/month/year)	
	GPs	**PLSs**
Molise • District of Campobasso • District of Isernia District of Termoli-Larino	Periodic update, website, 11/2018[1] Periodic update, pdf table, 10/2018[1] Unknow (list requested to the Public Relations Office), pdf table, unknown[2]	
Campania	Periodic update, website, 30/11/2022	Periodic update, website, 20/12/2022
Puglia	Continuous update, website, 23/05/2023	
Basilicata • Lagonegrese and Senisese • Val D'Agri • Potenza and Potentino • Vulture, Melfese and Alto Bradano	Continous update, Word table 15/12/2022 24/11/2022 16/01/2023 13/09/2022	Continous update, Word table 12/12/2022
Calabria ASP Cosenza ASP Catanzaro ASP Crotone ASP Reggio Calabria ASP Vibo Valentia	 Periodic update, website, 23/05/2023 Periodic update, website, 26/04/2023 Periodic update, pdf table, unknown[2] Periodic update, pdf table, unknown[2] Periodic update, website, 19/05/2020	 Periodic update, website, 23/05/2023 Periodic update, website, 26/04/2023 Periodic update, pdf table, unknown[2] Periodic update, pdf table, unknown[2] Periodic update, website, unknown[2]

ASP: national health trust (Azienda Sanitaria Provinciale), ASL: national health trust (Azienda Sanitaria Locale), GP: general practitioner, PLS: primary care pediatrician (pediatra di libera scelta), 1: date of update deducted by the file name, 2: date of update not reported and not deductible.

Supplementary Table 1. Continued.

Region	Frequency of update, distribution method, date of the list used in the study (day/month/year)	
	GPs	**PLSs**
Sicilia		
ASP Agrigento	Periodic update, pdf tables	Periodic update, pdf tables
• District of Agrigento	09/05/2023	22/09/2021
• District of Bivona	29/05/2023	30/11/2022
• District of Canicattì	03/01/2023	03/01/2023
• District of Casteltermini	06/09/2021	27/03/2017
• District of Licata	07/07/2022	27/03/2017
• District of Ribera	20/02/2023	27/03/2017
• District of Sciacca	14/02/2023	27/03/2017
ASP Caltanissetta	Periodic update, website, 22/09/2021	Periodic update, website, 01/10/2019
ASP Catania	Periodic update, pdf table, 13/04/2023	Periodic update, pdf table, 13/04/2023
ASP Enna	Periodic update, Excel table, unknown[2]	Periodic update, Excel table, unknown[2]
ASP Messina	Periodic update, website, unknown[2]	Periodic update, website, unknown[2]
ASP Palermo	Periodic update, pdf table, 12/05/2021	Periodic update, pdf table, 12/05/2021
ASP Ragusa	Periodic update, website, unknown[2]	Periodic update, website, unknown[2]
ASP Siracusa	Periodic update, pdf table, 01/12/2018	Periodic update, pdf table, 01/12/2018
ASP Trapani	Periodic update, pdf table, unknown[2]	Periodic update, pdf table, unknown[2]
Sardegna		
ASL Sassari	Continuous update, website, 23/05/2023	
ASL Olbia	Continuous update, website, 23/05/2023	
ASL Nuoro	Continuous update, website, 23/05/2023	
ASL Lanusei	Continuous update, website, 23/05/2023	
ASL Oristano	Continuous update, website, 23/05/2023	
ASL Sanluri	Continuous update, website, 23/05/2023	
ASL Carbonia	Continuous update, website, 23/05/2023	
ASL Cagliari	Continuous update, website, 23/05/2023	

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