HELATH CARE MANAGMENT

Characteristics of the health districts in Italy and their implication in primary health care policies: an analysis of socio-demographic trends

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Keywords

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Summary

Introduction. *The Health District (HD) is a critical component of Italy's National Health Service, responsible for ensuring Primary Health Care (PHC) services in response to community health needs. The Italian government established a national strategic reform program, the National Recovery and Resilience Plan (PNRR), starting in 2022, with a series of health interventions to reorganize the PHC setting, the main reform being the Ministerial Decree 77/2022 (DM77). Our study aimed to provide a description of socio-demographic data and to assess the correlation between HDs, in order to suggest health intervention priorities in PHC reforms.*

Materials and methods. *We conducted our analysis using a cross-sectional record linkage of data from multiple sources to compare organizational and socio-demographic variables. A dataset was created with each of the 21 Italian Regions' HDs data of population, land area, mean age, ageing index, old-age dependency ratio, birth rate and death rate. The Inland Areas Project data was integrated for a socio-economic perspective.*

Results. *Our study identified comparable groups of HDs, considering demographical, socio-economic and geographical aspects. The study provides a baseline understanding of the Italian situation prior to the implementation of DM77. It also highlights that inhabitants number cannot be the only variable to take into account for the definition of Italian HDs organisation and PHC reform, providing intercorrelated variables that take into account geographic location, demographic data, and socio-economic aspects.*

Conclusion. *By acknowledging the interplay of demographic, socio-economic, and geographic factors, policymakers can tailor interventions to address diverse community needs, ensuring a more effective and equitable PHC system.*

Introduction

In the Italian National Health System, the Health District (HD) is an articulation of the Local Health Authorities (LHAs) that is responsible for ensuring Primary Health Care (PHC) services to address community health needs. In Italy, together with the inauguration of a Beveridge-model taxes-funded National Health Service (NHS) [1], the concept of HD was introduced in 1978. Following a reform process based on principles of corporatization, NHS laws during the 90s [2] clarified HD functions as a centre of governance to provide social and health care integration. These reforms also set parameters like HD size (initially 60,000 people per HD, considering territorial and demographic aspects), and defined the role and functions of the Director of HD.

Subsequently, in 2001, the need to guarantee essential levels of care ("Livelli Essenziali di Assistenza", LEA) was reaffirmed, and a balanced budget for all Regional health systems was from then on required. In the same year, the amendment of Title V of the Italian Constitution [3] granted more autonomy to Regions in healthcare management, leading to a kind of healthcare federalism. Consequently, although the HD's functions and roles have been nationally defined in increasing detail over the years, the organisational features of the 21 Regional health care systems and the HDs have become extremely heterogeneous [4]. In the past decades many LHAs were merged, increasingly enlarging their catchment area, both in terms of population served and territorial extent (from 659 LHAs in 1992 to 99 LHAs as of 2021): Italian HDs, affected by this evolution, now have various organisational assets depending on Regional Laws and dispositions.

As a result of the pandemic and the ensuing economic crisis, the Italian government launched the National

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Recovery and Resilience Plan ("Piano Nazionale di Ripresa e Resilienza", PNRR) a reform program consisting of six financial assets, one of which related to the health sector, more specifically to PHC. In line with the PNRR, Ministerial Decree 77/2022 (DM 77) [5] redefined the organisational standard of the HD, including a population basin of 100,000 inhabitants and at least one community health centre, called Community House ("Casa della Comunità'', CdC) for every 40,000-50,000 inhabitants. Within the plan, the HD is identified as a place for application of new standards of care and for integration of all healthcare services of the LHAs [6]. Although, in the last decade, assessments by entities such as the National Agency for Regional Health Services ("Agenzia Nazionale per i Servizi sanitari regionali", AgeNaS) were published, detailed analyses focusing on the Italian HDs have been lacking [7]. Acknowledging the need for updated data on the Italian HDs, the authors conducted a study focusing on the socio-demographic situation as of January 1st, 2021. In particular, the study aim was to (i) carry out a quantitative description of the district articulations of the Italian LHAs and their territorial extension to 2021, (ii) provide a descriptive analysis of the socio-demographic data of the population residing in each HD and (iii) assess clustering of HDs with homogeneous features, (iv) assess clustering implications, in order to suggest health intervention priorities to meet the needs of the population.

Materials and methods

In the absence of a common official Italian database with information about HDs, along with the municipalities led by them, a cross-sectional record linkage analysis was conducted, to recreate it, by collecting data from various sources (Italian Ministerial documents and LHAs websites). Using data from the Italian National Institute of Statistics (Istat), we then gathered the following data for every municipality in the Italian territory, updated to January 2021:

- population;
- land area in square kilometres;
- mean age of the population;
- ageing index (ratio of population aged 65 years and older to population aged 0-14 years, multiplied by 100);
- old-age dependency ratio (ratio of population of non-working age, of 0-14 years and 65 years and older, to population of working age, of 15-64 years, multiplied by 100);
- birth rate (ratio of the number of live births for the year to the average amount of the resident population, multiplied by 1,000);
- death rate (ratio of the number of deaths for the year to the average amount of the resident population, multiplied by 1,000).

Data analysis and summarisation were performed using Microsoft Excel® for Microsoft 365 MSO (Version 2301 Build 16.0.16026.20196) 32 bit. To note, usually a single HD comprehends more than one municipality: out of 7,904 municipalities, in particular, 7,897 municipalities are part of just one HD. On the contrary, 7 municipalities, among the most populated of Italy, are divided into multiple HDs; in the database, they were inserted as separate entries with divided attributes.

To assess the impact of geographic characteristics on the population's health needs and HDs organisational setting, the municipalities were further categorised. Since a consensus in medical literature on the best way to categorize HDs territorial geography was not found, they were analyzed in light of the categories available in the framework of the Italian Ministry of the Interior's Inland Areas Project: the "Map of Inland Areas for the 2021-2027 cycle" ("Strategia Nazionale Aree Interne") [8], the latest publicly available downloadable dataset at the time of analyses for this study. In the document, the concept of Inland Area is defined as *those areas significantly distant from the centres that supply essential services (education, health and mobility), rich in environmental and cultural resources* [9]. In Italy, to date about a quarter of the population lives in these areas, in a portion of territory that exceeds 60% of the total territory.

Based on the above-mentioned document, 6 groups of municipalities can be identified:

- A - Pole;
- B - Intermunicipal Pole;
- C - Belt;
- D - Intermediate;
- E - Peripheral;
- F - Ultraperipheral.

Since the aim of our study was to assess each HDs' characteristics, we developed a score, called Inner Areas Score (IAS) in order to categorize HDs consisting of municipalities belonging to different groups. HDs were analyzed by defining a score for each of them on the basis of the municipalities therein, who were given:

- 1 point for municipalities in A area;
- 2 points for B;
- 3 points for C;
- 4 points for D;
- 5 points for E;
- 6 points for F.

After that, we determined the HDs' IAS based on the arithmetic mean of the composing municipalities' IAS. At the end of this process, each HD was assigned a score between 1 and 6 and; based on the score, HDs were categorised as follows: Central HDs (scores between 1 and 2); Intermediate HDs (scores between 3 and 4); Peripheral HDs (scores between 5 and 6).

Unless otherwise stated, categorical variables were summarised by frequencies and percentages. Median and interquartile ranges (IQR) were used to show continuous variables. We calculated descriptive statistics to identify the characteristics of the HDs' population and we stratified our sample for Regions. Furthermore, a univariate and bivariate analysis was conducted using the IBM SPSS Statistics Software version 28.0.1.0; we consider p-value set at < 0.05 as statistically significant.

The main results were highlighted by chi-square tests. Student's t test for independent samples was carried out. Shapiro-Wilk tests were used to assess normal data distribution, which resulted in a non-normal distribution for all variables ($p < 0.001$) (as shown in Tab. IV), except for the old-age dependency ratio ($p = 0.2$). Thus, parametric statistical tests were used exclusively for the old-age dependency ratio, while non-parametric tests (Mann-Whitney U test for independent samples) were used for all other variables. We used post-hoc Bonferroni correction to analyse categorical variables with multiple groups. We performed an ANOVA test on the old-age dependency ratio and the Kruskal-Wallis test on other variables. Furthermore, we used the Mann-Whitney U test to compare variables that appear to have statistically significant differences for each pair of groups in the post-hoc tests. To keep the alpha error at 5% we applied Bonferroni's corrective test: p-value = a/n, where alpha is the significance level and n is the number of post-hoc tests (*e.g.* 3 post-hoc tests need a Bonferroni correction of < 0.017 (0.05/3).

Results

Descriptive analysis of the Italian Health Districts Organizations and Policies

As of January 1st, 2021, the Italian territory included 7,904 municipalities and was subdivided in 545 HDs. Each HD included a median of 9 municipalities (IQR: 4-19) and covered an area of 419 square kilometres (IQR: 186-782 km^2). The total Italian population was 59,236,213 inhabitants [10]. Each HD provided services to a median population of 80,418 (IQR: 51,968-124,132 inhabitants), with extreme data regarding the Merano-Circondario HD in Bolzano Autonomous Province (1,380 inhabitants) and the Milan HD (1,374,582 inhabitants). The median population density was 194.3 persons/km^2 (IQR: 85.7-524.9; min: 13.6 persons/km^2 in Umbria Valnerina HD; max: 17,958.1 persons/km^2 in Campania HD 31).

As of 2021, the Italian population was reported to be 45.9 years old on average [11]. At the District level, a median of 46.1 years was observed (IQR: 44.7-47.6 years): the HD that recorded the lowest mean age was the Succivo District (38.4 years), in Campania, while the Italian HD with the highest mean age was Alto Vastese HD in Abruzzo (51.1 years). The national registered ageing index was 182.6 [12]. At the District level, a median ageing index of 191.4 was observed (IQR: 162.9-227 years): the lowest was 70.2 in Succivo HD, and the highest was 389.7 in Alto Vastese HD in Abruzzo. When compared to a national old-age dependency ratio of 57.3 [12], marked differences could be observed between HDs in terms of the social and economic burden of the inactive population: in 2021, a median ratio of 57.8 was observed (IQR: 54.7-60.8); the lowest value of 43.3 was recorded in Campania HD 47 while at the opposite extreme there was a maximum of 72.9 in the Alto Vastese HD of Abruzzo.

The birth rate in Italy, updated to 2021, was 6.8 per thousand inhabitants [12]. The median birth rate per HD was 6.7 per thousand inhabitants (IQR: 6-7.4): the lowest value was recorded in the HD of Ovada in Piedmont (4.1 per thousand inhabitants) and the highest birth rate was in the Bolzano HD of Val Passiria (14 per thousand inhabitants). Compared with a death rate of 11.9 in Italy [12], the HDs' average was 12.2 deaths per thousand inhabitants (IQR: 11-13.8); the lowest value was registered in Succivo HD in Campania (6.9 deaths per thousand inhabitants), and the highest was registered in the Alto Vastese HD (21.2 deaths per thousand inhabitants).

According to data as of 2021, strong variability among HDs per Region was reported. In every Region, there was an average of 22 HDs (IQR: 13-37), and every HD included typically 13 municipalities (IQR: 9-19). The catchment area ranged from a mean of 25,472 inhabitants per HD for Bolzano to a mean of 415,898 inhabitants in Lombardy. In extreme cases the differences were huge: for example, there is a marked contrast between Lombardy Region (almost 10 million inhabitants in 24 districts) and Campania Region (5.6 million inhabitants in 72 districts). The population density was on average 327.3 inhabitants per square kilometre (min: 42.7 in Valle D'Aosta; max: 2,070.7 in Campania).

The youngest Region was the Autonomous Province of Bolzano (mean age of 42.5 years) and the oldest was Liguria (mean age of 49.3 years). Likewise, the ageing index in 2021 was highest in Liguria (269.8) and lowest in Bolzano (119.1). The old-age dependency ratio in 2021 was highest in Liguria (66.3) and lowest in Campania (54.2). The average birth rate was highest in Bolzano (10.2 per thousand inhabitants) and lowest in Sardinia (5.1 per thousand inhabitants). The average death rate was highest in Liguria (16.8 per thousand inhabitants) and lowest in Bolzano (9.8 per thousand inhabitants). Table I summarises the main characteristics of HD's population, divided by Regions, as of 2021.

Comparing the current standard of 100,000 inhabitants per HD [5] with the catchment area of the HDs as of 2021, it was observed that 200 (37%) of them were oversized. Notably, the distribution by Region was very heterogeneous, ranging from Valle D'Aosta whose HDs were all within the set standard to Lombardy where 22 out of 24 HDs (91.7%) showed a population exceeding 100,000 inhabitants. This data is shown in Table II.

Although there was ample inter-district and inter-regional variability, the prevailing IAS was urban: overall, 135 (24.8%) of the 545 HDs consist of predominantly Central Poles, 361 (66.2%) Intermediate Areas, while only 49 HDs (9,0%) fall under the definition of Peripheral Area. The Region with the highest percentage of HDs whose catchment area was predominantly metropolitan was Friuli-Venezia-Giulia (50%). Calabria, Molise and Valle D'Aosta Regions had exclusively HDs with intermediate territorial scores. The Basilicata Region had the highest percentage of peripheral municipalities (55.6%). Data are shown in Figure 1.

Tab. I. HDs' population and demographic characteristics by Region until January 2021.

Region	N° LHAs	N° HDs	Municipalities (mean)	Population (Region)	Catchment area per HD			Mean age	Aging index	Dependency ratio	Natality	Mortality
					Min	Mean	Max					
Abruzzo	4	16	19	1,281,012	17,751	80,063	205,685	47.3	231.5	60.5	6.2	13.1
Basilicata	2	9	15	54,513	22,684	60,570	149,381	46.8	229.4	56.4	6.2	12.6
Calabria	5	16	25	1,860,601	25,098	116,288	253,252	45.2	185.0	57.2	7.5	11.4
Campania	7	72	8	5,624,260	30,230	78,115	159,745	43.4	148.0	52.4	7.9	10.5
Emilia-Romagna	8	37	9	4,441,353	32,220	120,037	391,686	46.5	195.9	59.3	6.6	13.4
Friuli-Venezia-Giulia	3	22	10	1,201,510	11,282	54,614	158,122	48.2	242.2	63.0	6.0	14.1
Lazio	10	40	10	5,730,399	31,164	143,26	314,135	45.6	176.0	55.3	6.6	10.9
Liguria	5	19	13	1,518,495	31,689	79,921	146,390	49.3	269.8	66.3	5.7	16.8
Lombardy	8	24	63	9,981,554	36,992	415,898	1,374,582	45.7	179.5	57.4	6.8	14.0
Marche	1	13	17	1,495,820	43,822	115,063	251,074	47.3	218.6	61.2	6.2	13.5
Molise	1	3	45	294,294	81,415	98,098	117,446	47.6	248.2	59.0	5.8	13.6
P.A. Bolzano	1	21	6	534,912	1,380	25,472	107,467	42.5	119.1	52.8	10.2	9.8
P.A. Trento	1	13	13	542,166	9,685	41,705	143,381	45.1	167.9	56.8	7.4	12.0
Piedmont	12	47	25	4,274,945	21,210	90,956	257,453	47.6	227.4	62.3	6.2	15.6
Puglia	6	45	6	3,933,777	37,128	87,417	317,205	45.5	186.6	56.2	6.7	11.3
Sardegna	1	24	16	1,590,044	10,722	66,252	248,690	48.3	260.3	58.9	5.1	12.5
Sicily	9	55	7	4,833,705	7,366	87,886	730,687	45.3	184.2	57.0	7.4	12.1
Tuscany	3	26	11	3,692,865	31,477	142,033	368,419	47.7	228.2	61.8	5.9	13.2
Umbria	2	13	7	865,452	11,315	66,573	192,756	47.9	231.9	63.3	5.9	13.1
Val d'Aosta	1	4	19	124,089	16,028	31,022	61,750	46.7	199.7	58.5	6.3	14.5
Veneto	9	26	22	4,869,830	25,604	187,301	315,158	46.4	194.5	57.4	6.6	11.9
Italy	**99**	**545**	**17**	**59,236,213**	**1,380**	**108,690**	**1,374,582**	**46.1**	**196.3**	**57.9**	**6.8**	**12.5**

Statistical multivariate analyses

After a preliminary descriptive analysis, bivariate analysis was carried out. We analysed data from the 2021 population after dividing HDs into two categories: HDs with more than 100,000 inhabitants and HDs with 100,000 inhabitants or less, given the cutoff identified by DM77 [5].

As expected, HDs with a population > 100,000 inhabitants usually had a higher number of municipalities, land area and population density and statistically significantly lower old-age dependency ratio values, when compared to the other HD groups.

The demographic indexes (mean age, ageing index, birth rate index, mortality index) had shown no statistically significant differences between HDs with less or more than 100,000 inhabitants (shown in Tab. III).

Central HDs present a smaller number of municipalities and mean surface area, while on the contrary, the mean population and population density were bigger than the other Areas, as shown in Table VI.

As shown in Tables V and VI, there was no statistically significant difference regarding the old-age dependency ratio and death rate index, while there were statistically significant differences for mean age, ageing index, which are lower, and birth rate index, which is higher, in Central HDs compared to other HDs.

Post-hoc test with Bonferroni correction was performed on categorical variables (Tab. VII) and showed statistically significant differences between the Central and Peripheral HDs, rather than between contiguous areas HDs (Central vs. Intermediate or Intermediate vs. Peripheral); in other words, differences could be seen more clearly between extreme data.

Discussion

This paper undertakes a comprehensive analysis of Italian PHC population and structure focusing on the Local HDs, a crucial component of the ongoing reform process.

The study, conducted before the DM 77 [5] shaped the primary healthcare setting, might serve as a baseline for subsequent studies on implementation and deployment

Tab. II. Number of Districts by Region and Population Size until January 2021.

Region	District Population				Total
	< 100.000 ab.	%	> 100.000 ab.	%	
Abruzzo	11	68.8%	5	31.3%	16
Apulia	37	82.2%	8	17.8%	45
Basilicata	7	77.8%	2	22.2%	9
Bolzano	20	95.2%	1	4.8%	21
Calabria	5	31.3%	11	68.8%	16
Campania	60	83.3%	12	16.7%	72
Emilia-Romagna	17	45.9%	20	54.1%	37
Friuli-Venezia-Giulia	21	95.5%	1	4.5%	22
Lazio	13	32.5%	27	67.5%	40
Liguria	13	68.4%	6	31.6%	19
Lombardy	2	8.3%	22	91.7%	24
Marche	4	30.8%	9	69.2%	13
Molise	2	66.7%	1	33.3%	3
Piedmont	31	66%	16	34%	47
Sardinia	19	79.2%	5	20.8%	24
Sicily	43	78.2%	12	21.8%	55
Trento	12	92.3%	1	7.7%	13
Tuscany	9	34.6%	17	65.4%	26
Umbria	11	84.6%	2	15.4%	13
Valle d'Aosta	4	100%	0	0%	4
Veneto	4	15.4%	22	84.6%	26
Italy	**345**	**63.3%**	**200**	**36.7%**	**545**

of the reforms in PHC and, in general, to make more conscious organisational decisions in PHC settings.

In accordance with the previous studies [4, 7], the present analysis confirms high heterogeneity in population density and land area extension in all HDs of each Italian Region (as shown in Tab. I and II), which is likely driven by a historically different implementation of the PHC services in HDs due to different Regional visions and municipalities compositions. The data collected implies, indeed, a diversity of conceptual models that could result in substantial differences in characteristics and volumes of offered services [7].

Moreover, this heterogeneity may be linked to the profound geographical and population distribution differences in Italy: as of now, Italian Regions have extremely various characteristics and areas, that range from mainly mountainous and small Regions like Valle D'Aosta (124,089 inhabitants) to more central and populous Regions like Lombardy (9,981,554 inhabitants).

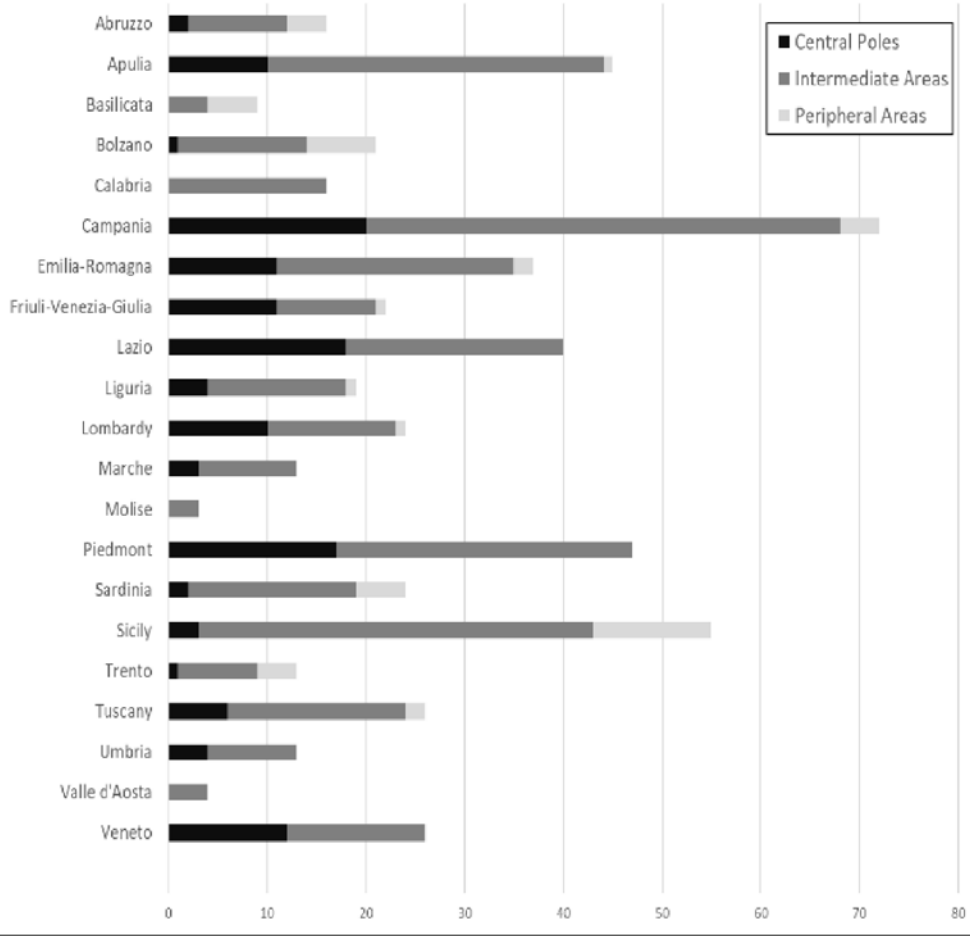
When studying HD composition, factors such as demographics (*e.g.* age or sex) and socio-economic status (*e.g.* income level, education level and employment) may have an impact on services utilisation if population composition substantially differs between geographical areas [7,13]. On the other hand, differences in geographically related factors, such as the number and type of healthcare facilities, may also lead to geographical disparities in healthcare use [14].

For these reasons, the study recommends a nuanced approach, beyond mere population numbers, for effective standardisation of HDs.

Considering demographic aspects, Italy's population (59,236.213 residents as of 2021) has been declining over the last decade. The average age has risen by three years since 2011 (from 43 to 46, as shown in Tab. I) [15]. The 2021 age structure is confirmed to be strongly imbalanced in favour of the elderly component of the population [15], with Italian population mean age rising year after year and a peculiar demographic pyramid.

The catchment area of the HDs represents a key organizational variable of the HDs. The median population of Italian HD is 80,410 (IQR: 51,968-124,132 inhabitants), while DM 77 reform suggests a catchment area of 100,000 inhabitants to standardise the characteristics of the HDs nationwide and to give input

Fig. 1. Number of HDs in Italian regions, divided into Central Poles (A + B); Intermediate Areas (C + D); Peripheral Zones (E + F).



Tab. III. Student's t test on old-age dependency ratio comparing HDs smaller than 100,000 persons to those bigger.

Variables	HDs' mean population ≤ 100,000	HDs' mean population > 100,000	p-value
Old-age dependency ratio	58.18	57.49	< 0.001

Tab. IV. Mann-Whitney U test on geographical and socio-demographic variables comparing HDs with less than 100,000 inhabitants to those with more.

Variables	HDs' median population ≤ 100,000	HDs' median population > 100,000	p-value
Number of Municipalities per HD	8	11.5	0.001
Land area in square kilometres	394.6	542.2	0.003
Population density	133	332.5	< 0.001
Mean age	46.2	46.1	0.552
Ageing index	196	187	0.056
Birth rate index	6.7	6.7	0.553
Mortality index	12.3	12	0.249

to Regions to uniformly implement PHC services. The study emphasizes the need of a defined catchment area and challenges the adequacy of the standards proposed by DM77: in order to better govern and manage the processes and health performance of the HDs (as well as for future analysis) a defined catchment area might not be enough to organize community health services [16].
Considering socio-economic aspects we decided to investigate the old-age dependency ratio: this index correlates to the economic inactivity of the population and it is an important variable to take into account at the governance level of services. The group of HDs with ≤ 100,000 inhabitants has a lower old-age dependency ratio (shown in Tab. III) than the other group. At the same time, the number of municipalities and population density as well as land area per HDs are higher for the HDs with > 100,000 inhabitants, whereas we find no statistical differences in mean age, ageing

Tab. V. One way ANOVA on old-age dependency ratio by IAS score groupings.

Variable	Mean of Central HDs	Mean of Intermediate HDs	Mean of Peripheral HDs	p-value
Old-age dependency ratio	57.63	57.73	58.82	0.117

Tab. VI. Kruskal-Wallis test on continuous variables by IAS score groupings.

Variables	Median of Central HDs	Median of Intermediate HDs	Median of Peripheral HDs	p-value
Number of municipalities in the HD	1	10	10	< 0.001
Population	132,988.5	86,327.5	42,297	< 0.001
Surface area in square kilometres	66	438.8	665.3	< 0.001
Population density	2,665.1	204.2	59.4	< 0.001
Mean age	46.1	46.1	46.8	0.038
Ageing index	178.4	189	217.9	< 0.001
Birth rate index	6.7	6.7	6.4	0.040
Death rate index	11.6	12.2	12.6	0.086

Tab. VII. Post-hoc test with Bonferroni correction on categorical variables.

IAS of the HDs	Number of Municipalities	Population	Surface area	Population density	Mean age	Ageing Index	Birth rate index
HDs of Central Poles *vs* HDs of Intermediate Areas	0	< 0.001	0	0	0.961	0.512	0.137
HDs of Central Poles *vs* HDs of Peripheral Areas	0	0	0	0	0.060	< 0.001	0.015
HDs of Intermediate Areas *vs* HDs of Peripheral Areas	0.994	0	< 0.001	0	0.013	< 0.001	0.074

index, birth rate index and mortality index between HDs with more and less than 100,000 inhabitants (shown in Tab. IV), demonstrating the homogeneous distribution of population between the Italian HDs.

The capillarity of the demographic analysis reaches the district level, in a manner similar to the ISTUD report [4], but adds various demographic indicators, from population size to territorial extension of the HDs, making it possible to observe some macro-phenomena characterising the Italian context.

Considering geographical aspects, in literature a possible difference between urban and mountain territories on PHC services availability was reported [7, 17]. In order to evaluate the impact of geographic characteristics on the population's health needs and the organisational setting of the HDs, we categorised the HDs into Central, Intermediate and Peripheral. Although there is a wide inter-district and inter-regional variability, the prevailing IAS is urban and only 49 HDs (9%) fall under the definition of Peripheral HD (shown in Tab. VI). Thus, it is possible to distinguish Regions whose territories are often mainly central or peripheral, so the Regional strategies might take into account this aspect. It may become topical again to debate whether there should be "Districts" shaped differently according to geographic location and population density since the expression of Public Health finds justification also with respect to these parameters [7].

Through the National Strategy for Inland Areas, we defined an operational way to identify territories very peripheral or distant to urbanised centres with an integrated supply of essential services. Thus, it is paramount not to forget this aspect when defining HD organisation and standardisation. In fact, we showed that when grouping the HDs following inhabitants criteria (more or less than median 100.000 inhabitants) (shown in Tab. IV) the demographic indexes (mean age, the Ageing index, the Birth rate index and the Mortality index) are homogeneous, but when considering the IAS data (shown in Tab. VI) the same indexes indicate the heterogeneity of the HDs. Among other variables, we found a higher mean age of the population and a higher ageing index in the Peripheral HDs, than in the Intermediate and Central ones. In Peripheral HDs there is lower population density, but more elders, often meaning more frailty and vulnerability [18] focused in some areas, needing dedicated social and health services. This work represents the first study in Italy that shows structural differences between HDs. In fact, the greater the level of peripherality of territories with respect to cities and big centres, the more complex the use of services and the worse the quality of life can be. It is possible to distinguish Regions whose territories are often mainly central or peripheral (shown in Fig. 1), so the Regional strategies could take into account this aspect.

Furthermore, our proposal of stratifying Italian HDs into homogeneous groups, according to conditions that influence the health management and population

size, collecting similar municipalities regarding common factors in health management, might allow the identification of comparable groups of HDs, setting up a consistent alternative to performance evaluation studies. The authors believe the Inner Areas Score developed can add an innovative contribution to scientific literature on the topic.

There are some limitations to this study. Since in Italy there is no database regarding the number and size of HDs, as well as the municipality included in each HD, this part of data collection was conducted with hand searching and manually retrieving information from Regional or local websites. So, it is possible that they may not have been updated in a timely manner, just as it is possible that the number may have changed in the meantime. Moreover, our study did not analyse the organisational and legislative choices of Italian Regions even though it would be important to an in-depth study of Regional Laws for a more accurate phenomenon comprehension.

Conclusions

The research showed profound heterogeneity of HDs according to geographic, demographic and socio-economic parameters. HDs are responsible for the multi-sectoral integration of Public Health and PHC, and the finding that there are structural and statistically significant differences between HDs has important consequences in terms of management and implications that policymakers must take note of in policy development.

The ongoing reform [5] of territorial assistance in Italy fits into this scenario and aims at standardisation and homogenization of territorial care. From the data shown, it is difficult to imagine that a standardisation process could meet the needs of such heterogeneous territories without taking into account the demographical, geographical and socio-economic parameters of every HD.

In conclusion, since the population data cannot be the only variable to take into account for the definition of Italian HDs organisation and PNRR reorganisation, we provided a system of intercorrelated variables that take into account geographic location, demographic data, and other aspects, which is reliable and easy to use.

Further investigation will be necessary to assess the level of applicability and enforceability of the established standards and deepen the investigation of other socio-economic indexes.

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Conflict of interest statement

All authors report no conflicts of interest relevant to this article.

Authors' contributions

EG, IS, ARC, AC, AT, ES, SF, GS: conceptualization. EG, IS, ARC, AC, ES, SF, GS: data curation. ARC: formal analysis. IS, ARC, AC, GP: methodology. EG, ARC, ES, GP: resources. EG, IS, ARC, AC, MDP, AT, GP: writing original draft. EG, IS, ARC, AC, MDP, ES, GS: writing review and editing.

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