ORIGINAL ARTICLE

Influenza vaccination coverage and deprivation among the elderly in the municipality of Cagliari: results and perspectives

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Keywords

Influenza vaccination • Deprivation • Elderly • Fragility

Summary

Introduction. *The elderly are among the main targets of influenza vaccination campaigns. Previous studies have shown that socio-economic status influences compliance with influenza vaccination, particularly in the elderly. Deprivation indexes can therefore be useful in identifying population groups with lower vaccination uptake and guide targeted intervention to improve vaccination coverage. We analysed the correlation between influenza vaccination coverage and levels of socio-economic and health deprivation among the population of Cagliari, by means of an Index of Socio-Economic and Health Deprivation (SEHDI) specifically tailored to the city, in order to identify population subgroups needing specific intervention to improve vaccination coverage.*
Methods. *A combination of linear regression, factor analysis and cluster analysis was adopted in order to build the SEHDI at the Census Tract (CT) level; data were taken from the 2011 Italian Census. Mortality among subjects aged ≥ 65 years in Cagliari in the period 2013-2015 was used to select the SEHDI variables. On the basis of the SEHDI, his population was classified into five normalised deprivation groups. Information on vaccination coverage was provided by general practitioners and Local Health Units. Cause-specific mortality and information on vaccination coverage in the deprivation groups were analysed by means of ANOVA (F test at $p < 0.05$).*
Results. *Around 20% of the Cagliari population was seen to be living in disadvantaged conditions. The trends in Standard Mortality Rates (SMRs) for all causes and for respiratory diseases, chronic obstructive pulmonary diseases (COPD), influenza and pneumonia were analysed across the deprivation groups. Pneumonia and flu mortality rates displayed a non-linear trend in men and a positive linear trend in women. Flu vaccination uptake rates were low: 27%. Coverage proved to be lower in the two extreme categories and higher in the medium deprivation ones.*
Conclusions. *The correlation between low vaccination coverage and socio-economic deprivation not only underlines the important role of vaccination in safeguarding health, but also the fact that it can be considered a factor in ensuring the system's equality, thanks to its role in limiting health impacts on those living in the most problematic or disadvantaged circumstances. It also stresses the characteristics which contribute to low compliance. Therefore, this finding should be taken into account in the organization of vaccination campaigns and should prompt differentiated interventions in each local area.*

Introduction

Cagliari is the capital of the autonomous region of Sardinia, a large island of south-western Italy. Situated on the south tip of the island, the city looks out over the Gulf of Cagliari. The Metropolitan Area of Cagliari comprises the municipality of Cagliari and 16 neighbouring municipalities; some share borders and close urban connections with the capital, while others are located in the hinterland. According to statistics from 2016, the municipality of Cagliari has a population of 154,639 (smaller than those of other Italian region capitals), while the Metropolitan Area comprises 430,000 residents, around a quarter of the total population of Sardinia in just 5.2% of the island's surface area [1].
In the social context of the city, municipal borders are no longer significant. The municipalities are closely interconnected and the city's population moves frequently among them, sharing services, social spaces and working environments [2]. In this context, the city of Cagliari displays some unusual characteristics. For example, while the population of the Metropolitan Area is younger and more active than the Sardinian average, the population of the capital includes a very high percentage of elderly people: 26.5% are over 65 years of age, and the ageing index is 258.2 [1]. Indeed, the younger members of the population, even those who work in the capital, find it more economical to live in the surrounding municipalities.
In this specific context, the study of socio-economic status (SES), which is a composite concept that includes material and social deprivation [3-5], has both advantages and limits. On the one hand, it may be able to identify the needs of the elderly; on the other, however, it may partially overlook the needs of younger people who reside outside the municipality but make use of the city's public and social services for health purposes.
The target population of the study consisted of subjects aged ≥ 65 years; therefore, the effect of this demographic characteristic on the relationship between SES and

health needs and influenza vaccination coverage does not affect the reliability of the results. For an analysis of the health condition of the younger population, the study would have to be extended to the wider metropolitan area, but this is beyond the purpose of the study.

Every year, about 8% of the Italian population catch influenza [6]. Although the elderly are less frequently affected, they develop more complications after the disease and 90% of deaths due to influenza and complications occur in this age group [7]. As the mortality risk is higher in unvaccinated elderly subjects than in the vaccinated elderly [7], vaccination is strongly recommended.

The role of SES is crucial in determining adherence to immunization against influenza, particularly in the elderly [8]. The use of synthetic deprivation indexes is an effective strategy for measuring health disparities at the population level, and also for identifying non-vaccinating groups, not least because this method takes into account the aspect of social support, which is particularly relevant in elderly people [9].

The aim of this study was to identify population groups aged ≥ 65 years with lower vaccination coverage in Cagliari by means of a specific socio-economic and health deprivation index (SEHDI) based not only on the SE characteristics of the population but also on its specific health needs, with a view to orienting targeted interventions aimed at increasing compliance with influenza vaccination.

Materials and methods

As per the time-scale of the project, the first step was to develop the SEHDI in accordance with a previously tested method [10]. The SEHDI enabled us to classify the population into five deprivation categories (high deprivation, medium-high deprivation, medium deprivation, medium-low deprivation and low deprivation), and to normalize the population distribution by group [11].

Gathering mortality data on the whole population and information on flu vaccination coverage among the over-65's required close collaboration with the Public Health and Hygiene Service (SISP) of the Cagliari Socio-Health Prevention Department (ASSL Cagliari) of the Sardinian Health Protection Agency (ATS).

Mortality data, which were essential to calculating the SEHDI, were drawn from the RENCAM database at the individual level, and regarded the period 2013-2015. The working staff devoted particular attention to the addresses of residence, in order to verify their correspondence to the 2011 Census Tracts. Indeed, the geo-coded mortality data allowed us to select from the 2011 Italian Census the demographic and socio-economic variables used to built the SEHDI, in accordance with the method of Lillini et al. [10]. Subsequently, all respiratory causes of death (ICD10: J00-J99) were extracted; the following specific causes – COPD (ICD10: J40-J47) and Influenza and Pneumonia (ICD10: J10-J18) – were then analysed according to SEHDI groups of population, along with all respiratory diseases and overall mortality.

Mortality was analysed in terms of Standard Mortality Rates (SMR), computed by gender and age group (0-64, 65+ years), and regional mortality rates were used as the reference figures.

Influenza vaccination data were retrieved from two information sources: the vaccinations database at the two clinics at SISP's central site in Cagliari, and reports from general practitioners' vaccination certification records. In the year considered, the two databases were handwritten and archived in paper form at the SISP site.

Differences in SMRs and vaccination coverage across the SEHDI groups were analysed by means of ANOVA with F-test and linearity tests (statistical significance at $p < 0.05$), considering age groups (0-64, 65+) and gender [12]. The Pearson correlation test (statistical significance at $p < 0.05$) was used to evaluate the association between vaccination coverage and the single demographic and socio-economic variables, in order to better describe the population characteristics, and to determine where and how to focus specific intervention to improve vaccination compliance [12].

The analyses were performed by means of SPSS 19.0 and Stata 13.0 statistical software.

Results

In Cagliari, the SEHDI was based on three factors, and developed a total explained variance of 56.4% (Tab. I).

The three factors mainly concerned demographic aspects of the population, particularly the family structure, housing conditions and occupational status, mainly among males.

Validation according to the main synthetic ISTAT socio-economic and demographic indices confirmed the ageing of the population, with a linear increase in the old-age index, structural dependency index and replacement index as deprivation grew. By contrast, as expected, the activity rate decreased linearly as deprivation increased (Tab. II).

No statistically significant difference was seen in the employment and unemployment rates across the SEHDI

Tab. I. Composition of SEHDI by 2011 Census variables. SEHDI factors and explained variance.

Factor 1 = 24.5%	Factor 2 = 16.7%	Factor 3 = 15.1%
Average no. of people per family Average no. of people per occupied dwelling % 3-member families	% housing with drinking water % housing with kitchen % married % students	% belonging to labour force % men
Total variance explained by Cagliari SEHDI = 56.4%		

Tab. II. SEHDI general validation.

Deprivation groups	Replacement index	Old-age index	Index of structural dependence	Activity rate	Employment rate	Unemployment rate
High deprivation	271.98	566.28	106.07	43.26	60.79	11.59
Medium-high deprivation	265.22	372.47	61.41	49.30	59.23	12.53
Medium deprivation	219.61	301.22	54.49	52.59	60.55	11.32
Medium-low deprivation	206.15	242.88	50.81	54.19	59.25	12.40
Low deprivation	127.10	100.38	40.40	60.40	63.03	10.02
Total	***223.78***	***311.50***	***58.08***	***51.99***	***60.13***	***11.77***
Trend	***p<0.05 L↑***	***p<0.05 L↑***	***p<0.05 L↑***	***p<0.05 L↓***	***NS***	***NS***

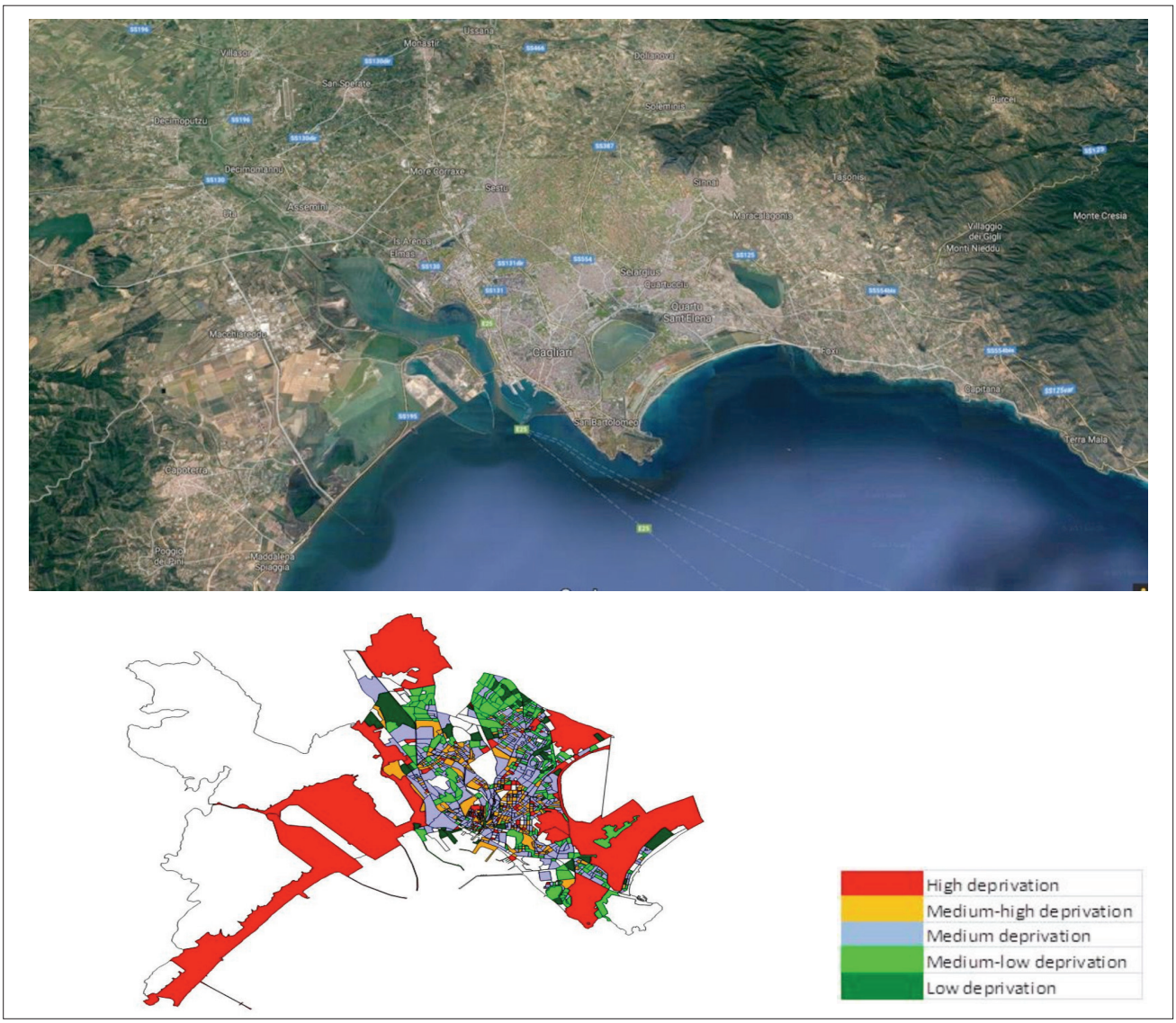
Trend: p<0.05 L↑ = linear positive; p<0.05 L↓ = linear negative; p<0.05 NL = not linear; NS = not significant.

groups, owing to the high presence of aged people, outside the labour market, as discussed above.

The SEHDI distribution revealed that at least 22% of the population lived in disadvantaged conditions, most of whom (53%) fell into the medium deprivation category; 25% displayed a socio-economic advantage. It is interesting that the extreme groups are really the tails of the population (2.9% of population in the high deprivation group, 1.6% in the low deprivation group).

Grouping the population of Cagliari according to the SEHDI allowed us to create a socio-economic map of the municipality, which can be compared with the Aerial photo of the area (Fig. 1).

Fig. 1. Aerial photo and map of Cagliari showing the spatial distribution of the SEHDI by census tract.



Low and medium-low deprivation were present in most parts of the historical centre and in the residential eastern areas, but also in areas where they might be less expected, such as working-class neighbourhoods in the southern districts. High and medium-high deprivation areas were more frequently located near the harbour and on the borders of the municipality, though they also appeared in middle-class neighbourhoods. It is noteworthy that the most deprived areas bordered on (and were part of) the industrial areas or were located close to the large ponds immediately around the city.

The overall mortality rates displayed a statistically significant linear increase as deprivation grew, with an almost double risk of death in the high deprivation group and only a third of risk in the low deprivation group.

Owing to the small dimensions of the city, deaths due to respiratory diseases were few However, an interesting (and statistically significant) difference emerged between the two genders in the elderly. Indeed, in women, all respiratory diseases displayed a linear increasing trend as deprivation increased, and similar variations for COPD, and pneumonia and influenza. In elderly men, however, the relationships were non-linear; this was strongly dependent on the distribution of COPD, which was more frequent among men (Tab. III).

According to the rates reported in the study, vaccination coverage among the over-65's in Cagliari stood at a very low level, 27%. The distribution of coverage across the five population categories was Gaussian. Vaccination coverage was lower at the two extremes of the index (Fig. 2). However, compliance was greater in the high deprivation group than in the low deprivation group.

Vaccination coverage was lower in contexts with more women, married and divorced couples, university or high school graduates, members of the workforce and salaried workers, 2- or 3-member families and over-65s living alone, and where the average number of people per household and per family, structural dependence index and employment rate were higher.

Discussion and conclusions

The study was aimed at analysing the link between vaccination coverage and the social, economic and health status of the population. It focused on how the use of a specific local deprivation index, the SEHDI, can help to identify the relationship between socio-economic inequalities and aspects of healthcare prevention in Cagliari.

The SEHDI refers not only to material deprivation (income factors or the ability to pay for goods or services, etc.), but also to social deprivation (for example, difficulty in accessing treatment or prevention if no one can provide help) and to the cultural/educational level (comprehension of healthcare information and correct use of services etc.) [3, 10]. Furthermore, the SEHDI yielded a detailed geographical description of the population's health conditions; for this reason, it could be used to improve the classification and description of the population and to guide public healthcare choices [13, 14].

Our results showed a close relationship between deprivation and overall mortality in the elderly. With regard to respiratory disease mortality and mortality due to flu and pneumonia, by contrast, the relationships were not linear when both genders were pooled. This was determined by the non-linear trends seen in men; in women, the trends were linearly positive, which testifies to their greater economic and social fragility.

Vaccination coverage among the over-65's in Cagliari was 27%; this rate is far below the ideal minimum level (75%) and the national (52%) and regional (41%) averages. The non-linear relationship between vaccination coverage and deprivation may be explained in two ways. First, coverage is lower in the groups at both ends of the deprivation scale; this suggests different responses to recommendations on prevention, probably as a result of different cultural levels. At the same time, the groups with the lowest coverage rates include more, among whom social fragility is more prevalent. Indeed, women more often live alone, and are therefore less likely to have adequate family support or easy access to healthcare or public social assistance.

Thus, vaccination is important not only in safeguarding health,; it is also a factor in ensuring the system's equality, owing to its role in limiting health impacts on those living in the most problematic or disadvantaged circumstances [15, 16]. This study lays down a framework for discussion regarding prevention through tools that can be adapted to the contexts in which adherence to vaccination is unsatisfactory. It does this through a verified methodology and a viewpoint that focuses, as far as possible, on the local perspective, and by adding further fuel to the debate on the need to tackle healthcare inequality efficiently and with specific weapons.

Although the sociological dimension would favour a study encompassing the entire Metropolitan Area, the lack of information systems and municipal databases made a project on this scale impractical; for this reason, the present study is currently limited to the Municipality of Cagliari.

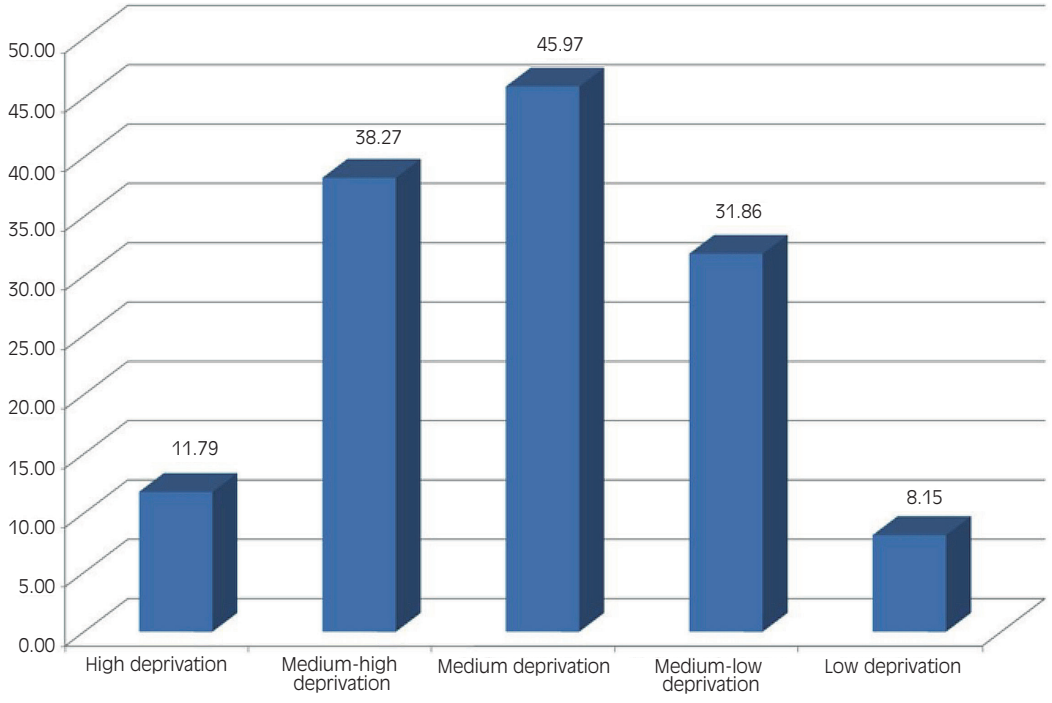
On 6th December 2018, a conference entitled "Fragility and the right to healthcare protection. Flu vaccination: criticality and opportunity in the face of healthcare inequalities" was held in Cagliari. On that occasion, the data that emerged from this study were presented and the relationship between socio-economic factors and access to prevention services in Cagliari was further examined, with a view to building on the present results through reflection and discussion with healthcare personnel. We hope this initiative will prompt a strong response from the health system in terms of improving strategies to promote vaccination.

Tab. III. Overall mortality and mortality due to respiratory diseases, influenza and pneumonia, and COPD in the elderly in Cagliari city, by gender and deprivation (period 2013-2015). Number of deaths (OBS), Standard Mortality Ratios (SMR) and statistical significance (p).

Cause	Deprivation groups	Males + females			Males			Females		
		OBS	SMR	p	OBS	SMR	p	OBS	SMR	p
Overall mortality	High deprivation	209	1.27	*	71	1.27		138	1.27	*
	Medium-high deprivation	1041	1.11	*	426	1.09		615	1.13	*
	Medium deprivation	2299	0.99		1063	0.98		1236	1.00	
	Medium-low deprivation	605	0.79	§	324	0.78	§	281	0.80	§
	Low deprivation	15	0.41	§	8	0.35	§	7	0.51	§
	Total	**4169**	**0.99**		**1892**	**0.96**		**2277**	**1.01**	
	Trend	***p<0.05 L↑***			***p<0.05 L↑***			***p<0.05 L↑***		
Respiratory system	High deprivation	17	1.48		4	0.87		13	1.90	
	Medium-high deprivation	59	0.88		22	0.68	§	37	1.08	
	Medium deprivation	169	1.01		99	1.11		70	0.90	
	Medium-low deprivation	34	0.60	§	18	0.52	§	16	0.73	
	Low deprivation	0	0.00	§	0	0.00	§	0	0.00	§
	Total	**279**	**0.92**		**143**	**0.88**		**136**	**0.96**	
	Trend	***p<0.05 NL***			***p<0.05 NL***			***p<0.05 L↑***		
influenza & pneumonia	High deprivation	5	2.04		1	1.23		4	2.44	
	Medium-high deprivation	24	1.72	*	6	1.05		18	2.19	*
	Medium deprivation	50	1.46	*	22	1.40		28	1.51	
	Medium-low deprivation	8	0.71		3	0.49		5	0.95	
	Low deprivation	0	0.00	§	0	0.00	§	0	0.00	§
	Total	**87**	**1.39**	*	**32**	**1.12**		**55**	**1.62**	*
	Trend	***p<0.05 NL***			***p<0.05 NL***			***p<0.05 L↑***		
COPD	High deprivation	4	0.69		1	0.38		3	0.93	
	Medium-high deprivation	23	0.67	§	12	0.65		11	0.68	
	Medium deprivation	81	0.93		53	1.05		28	0.77	
	Medium-low deprivation	23	0.77		15	0.77		8	0.77	
	Low deprivation	0	0.00	§	0	0.00	§	0	0.00	§
	Total	**131**	**0.83**	**§**	**81**	**0.88**		**50**	**0.75**	**§**
	Trend	***NS***			***p<0.05 NL***			***NS***		

Standard Mortality Rates were referred to those of the Sardinia Region. P = test F; p<0.05: * = significantly increased risk; § = significantly decreased risk. Trend: p<0.05 L↑ = linear positive; p<0.05 NL = not linear; NS = not significant.

Fig. 2. 2015-2016 vaccination coverage (%) among the elderly in Cagliari, by deprivation group.



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Conflict of interest statement

None declared.

Authors' contributions

AL and LM made substantial contributions to the conception and design of the study, and/or to data acquisition (AL, LP), analysis and interpretation (AL, LP, LC, LM, RL, MV). AL, RL and MV participated in drafting the article or revising it critically for important intellectual content. All authors give their final approval of the version to be submitted and any revised version.

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