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The local Socio-Economic Health Deprivation Index: methods and results

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Keywords

Health disparities • Socio-economic inequalities • Deprivation index • Public health

Summary

Introduction. *A socio-economic (SE) deprivation index is a measure that aims to provide an indication of SE hardship and disadvantage in the population. Our aim was constructing 10 Socio-Economonic and Health Deprivation Indexes (SEHDI) by means of the same method. This particular method enables these indexes to be used to investigate the relationships between SE inequalities and aspects of health and prevention in the population.*

Materials and Methods. *Data on the demographic and SE situation of the populations were taken from the 2011 Census at the Census Tract (CT) level (2001 for Rome municipality). To construct the SEHDIs, variables displaying a statistically significant correlation with the SMRs of overall mortality were subjected to a tolerance test of linearity, in order to eliminate collinear variables. The variables selected underwent PCA factor analysis, in order to obtain the factors to be linearly combined into the SEHDI. The final values were scaled from minimum to maximum deprivation, and the quantitative scale was converted into five ordinal normalized population groups. The SEHDIs were validated at the SE level by comparing them with the trends of the main SE indexes used in the 2011 Census (2001 for Rome municipality), and at the health level by comparing them with the trends of some causes of death. Both comparisons were made by means of ANOVA.*

Results. *The 10 areas considered were: the municipalities of Cagliari, Ferrara, Florence, Foggia, Genoa, Rome, Palermo, Sassari, Siena, and the ULSS 7 Veneto area. For each one, a specific SEHDI was computed and the different variables comprising each index focused on particular aspects of SE and health deprivation at the area level. The SEHDIs showed good percentages of explained variance (from 72.2% to 49.1%) and a linear distribution of the main statistical SE indices and of overall mortality in each area; these findings were in line with the literature on the relationship between the SE condition and health status of the population. The distribution of cause-specific mortality across the SEHDIs deprivation clusters is analyzed in other articles, which deal with the findings of the study in each area.*

Conclusions. *The SEHDIs showed good ability to identify the elements of SE inequalities that impact on the health conditions of populations; to depict the distribution of causes of death that are sensitive to SE differences concerning aspects of the social and family support structure. From a public health perspective, these results are relevant because they enable interventions of health promotion and prevention to be implemented on the basis of the characteristics that define deprivation groups.*

Introduction

A socio-economic deprivation index is a measure that aims to provide an indication of socio-economic hardship and disadvantage through a synthetic value [1, 2]. It generally refers to the living conditions of the inhabitants of a given geographical/administrative area, which may be defined topographically and/or normatively (e.g., the municipality or the Census Tract) [3-6]. As the index can be calculated by means of the same methodology in different areas, the population clusters obtained constitute analogous segments of different populations. Thus, comparisons can be made between the conditions of populations residing in different areas.

Deprivation indexes are usually computed in order to achieve general and specific objectives. The general objective is to describe relative deprivation within a population, while specific objectives may regard many aspects of economic, social, health or political issues.

As the present study focused on public health, the specific objectives can be summarized as follows:

- to obtain relative deprivation measures in order to identify critical points in the territory;
- to study the association between deprivation and health outcomes;
- to correct epidemiological evaluations of the association between other environmental factors and health outcomes.

The socio-economic health deprivation indexes used in this project were constructed in accordance with a specific methodology that makes them particularly suitable for investigating the relationships between socio-economic inequalities and aspects of health and prevention in the population, as verified by their use in previous studies [7-9].

Our aim was to compute a specific Socio-Economic and Health Deprivation Index (SEHDI) for each of the 10 areas involved in the study by using the same methodology, in order to precisely identify the elements that characterized specific socio-economic and health differences in different populations.

Materials and methods

Materials

Data on the demographic and socio-economic situation of the populations involved in the study were taken from the 2011 ISTAT Census of Population and Housing (2001 for Rome municipality).
We considered all variables made available publicly by ISTAT on its website [10] (a total of 152), plus a set of variables made available ad hoc for this study (a total of 24). The complete list is presented in Table S1, in the Supplementary Materials section of this article.
For the 10 geographical areas participating in the study (municipalities of Cagliari, Ferrara, Florence, Foggia, Genoa, Rome, Palermo, Sassari, Siena, and the ULSS 7 Veneto area) all the variables were considered at Census Tract (CT) level.
The maps used to produce a geographical representation of the indexes were taken from the ISTAT website in shapefile format; the reference system for representing the coordinates is the ED 1950 UTM Zone 32n [10].
To select the ISTAT variables composing the SEHDIs, we collected data on observed deaths due to all causes, at the CT level, in the 5-year period centered around 2011 (year of the Census; 2001 for Rome municipality), i.e. the period 2009-2013.
To validate the SEHDIs, we collected data on observed deaths (again at the CT level), broken down according to the main causes and to causes concerning the respiratory system (particularly relevant for the study) in the 5-year period 2009-2013. The complete list is shown in Table I, in which the observation periods and any local changes in these (depending on local updating of mortality data) are also indicated.
Collection of mortality data was enabled by collaboration among Municipalities, Regional Statistical Offices and, where present, Regional Mortality Registries. In some areas, ICD-9 codes were assigned to mortality data; these codes were then translated into ICD-10 codes. Table I also reports the correspondence between the two coding revisions.
Some Operating Units adopted slightly different observation periods, depending on the availability of the data. However, it was deemed that these differences would not compromise the reliability of the final result, as they were always close to the period in which the demographic and socio-economic data of the Census were gathered.

Methods

To construct the SEHDI, a consolidated method was implemented in every area [4]; this used a combination of bivariate and multivariate statistical techniques [11].
The variables from the Census were first examined in order to eliminate any outliers in the data; they were then converted into percentages of the total population. Subsequently, all the percentages obtained were correlated with the general mortality rate in each area, standardized by age on a regional basis (Standard Mortality Rates - SMR). Correlations were computed by means of the Pearson correlation index, with the statistical significance of the correlation being set at $p < 0.05$.
After this procedure, only the variables that were statistically significantly correlated with the SMRs were considered. A tolerance test of linearity was applied (statistical significance at $p < 0.05$), in order to eliminate all the ISTAT variables that were excessively collinear (level of tolerance $p < 0.001$) [11].
A Principal Component factor Analysis (PCA) was then carried out on the variables selected (with varimax rotation of the components, in order to orthogonalize them and make them independent of each other). Only components with eigenvalues ≥ 1 were considered [11]. These components expressed a substantial part of the variance, i.e. the variability of the distribution of the socio-demographic characteristics of the population observed, and were therefore the basic elements for the final computation of the SEHDI.
The SEHDI was calculated as a linear combination of factors coming from the PCA. The variable obtained was

Tab. I. Causes of death and observation periods in the study.

Causes of deaths (observation period: 2009-2013[1])	ICD-10	ICD-9
All causes	A00-Y89	001.0-E999.9
Cardiovascular system	I00-I99	390.0-459.9
Respiratory system	J00-J99	460.0-519.9
Flu and pneumonia	J10-J18	480.0-487.9
COPD	J40-J47	490.0-496.9
Digestive system	K00-K93	520.0-579.9
Diabetes	E10-E14	250.0-250.9
All cancers (except non-melanoma skin cancers)	C00-C43, C46-C95	140.0-172.9,176.0-208.9
Upper aero-digestive tracts cancers	C00-C15	140.0-150.9
Stomach cancers	C16	151.0-151.9
Colorectal and intestinal cancers, not otherwise specified	C18-C21, C26.0	153.0-154.9, 159.0
Lung cancers	C33-C34	162.0-162.9
Female breast cancers	C50	174.0-174.9
Prostate cancers	C61	185

[1] Different periods for the following areas: Cagliari: 2013-2015 Palermo: 2009-2016; Ferrara: 2010-2015 Sassari: 2013-2015.

then recalculated by applying values from 0 (= maximum deprivation) to 100 (= minimum deprivation). The index was obviously computed at the CT level for each of the 10 areas involved in the study.
The quantitative SEHDI was then converted into an ordinal variable that expressed deprivation in the population groups. To maintain the criterion of the normal distribution of inequality in the population [12, 13], the Agnelli, Cadeiras, Tabak, Turner and Vander-Eijden algorithm [14] was applied. By this classification, the deprivation groups presented an almost normally distributed number of people across the groups (statistical significance at $p < 0.05$). These groups were: 1 = high deprivation; 2 = medium-high deprivation; 3 = medium deprivation; 4 = medium-low deprivation; 5 = low deprivation.
The ordinal index thus obtained was validated: i) at the socio-economic level, by comparing it with the trends of the synthetic socio-economic indexes used in the 2011 Census (old-age index, structural dependency index, turnover index, activity rate, employment and unemployment rates; the same 2001 indexes for Rome municipality); and ii) at the health level, by comparison with the available data on causes of death.
In both comparisons, One-Way ANOVA was used with the F test and linearity test ($p < 0.05$) [11], in order to assess whether the trends yielded by the ordinal version of the index corresponded adequately to what is known in the literature on the relationships between socio-economic inequalities and causes of death. In addition to obtaining an adequate validation of all the indices, this procedure also yielded a fairly detailed evaluation of the state of health of the populations involved in the study.
The statistical analyses were conducted by means of SPSS 19.0 and STATA 13.0 software.

Results

For the 10 areas considered, a specific SEHDI was computed. In accordance with the methodology used, each local index comprised variables that focused on specific aspects of socio-economic and health deprivation at the local level. Table II reports the composition of each index.
On PCA, all the indices showed a good percentage of explained variance (from 72.2% to 49.1%), indicating an adequate ability to describe the distribution of deprivation in the population studied. Moreover, in every area, the validation procedures showed a good linear distribution of the main ISTAT socio-economic indexes and of overall mortality; this is in line with the hypothesis underlying this computation method and with the scientific literature on the relationships among the deprivation, general socio-economic condition and health status of a population (Tabs. IIIa, IIIb).
Several analyses were carried out in order to investigate the association between the SEHDI and cause-specific mortality, mainly as a validation tool. In some cases, the findings were discussed in detail by some of the other groups participating in the study (data not shown).
Finally, Table IV reports the distribution of the population in deprivation clusters in every area.

Discussion and conclusions

The indexes calculated in this study cannot be considered "pure" socio-economic deprivation indexes, because they use standardized general mortality as the very first tool for the selection of the Census variables.
Indeed, only variables that correlated with overall mortality were included in the indexes. However, they enabled SE inequalities across the different deprivation groups to be assessed, even though connected to their health status.
For example (Tab. II), some aspects that are common to every area distinguish subjects mainly on the basis of their need for social and practical support, and thus, the family structure that may help or hinder prevention or care patterns and the implementation of a healthy lifestyle [15-17]. Other characteristics, such as educational level and/or housing conditions, display a differential impact on stratification by socio-economic conditions from area to area (i.e., they express more or less variance) according to the specific situation of the labor market, of the housing market etc.
These peculiarities makes the SEHDI particularly suitable for studying the relationship between socio-economic and health aspects (of care, prevention, etc.) in a population (which was exactly the objective of this project). They are therefore indexes that could be defined as "purpose-built" [3-6].
Another important feature that enables them to describe the peculiarities of a specific area efficiently is their territorial detail: the Italian CTs are usually small in demographic terms (around 800 people on average). This characteristic allows us to consider the smallest available area of officially validated demographic and socio-economic information and, at the same time, an area small enough to be able to describe the reference context attributable to individual patients [5, 6], i.e. every person can be described by the demographic and socio-economic characteristics of his/her CT of residence, with a low risk of ecological bias [5, 6].
Starting from these latter considerations, the SEHDI showed:

- good descriptive ability to identify the relevant elements of socio-economic inequalities that impact on the health conditions of the different populations involved in the study;
- good ability to describe health problems related to some causes of death that are particularly relevant to socio-economic differences, in which the aspects of family and social support structure are also relevant;
- good description of the characteristics that underlie the differences in VC across the different deprivation groups.

Tab. II. Composition of the SEHDI in each area, by 2011 (2001 for Rome municipality) Census variables. SEHDI factors and explained variance.

Area	Factors				
Cagliari (56.4%)[1]	1 = 24.5%	2 = 16.7%	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 labor force % men		
Ferrara (62.3%)[1]	1 = 29.8%	2 = 19.8%	3 = 12.7%		
	% earners from labor or capital income % widowers/widows Index of structural dependence Old-age index % single-member families 65+ % primary school diploma	% 2-member families	% residential buildings in mediocre state of conservation % housing with kitchenette		
Florence (60.7%)[1]	1 = 30.9%	2 = 16.6%	3 = 13.2%		
	Average no. of people per family Average no. of people per occupied dwelling % 4-member families % married	% rented homes % foreigners and stateless persons residing in Italy	% widowers/widows % belonging to labor force % lower secondary school		
Foggia (68.9%)[1]	1 = 38.1%	2 = 16.1%	3 = 14.6%		
	% single-member families 65+ % widowers/widows % single-member families Average no. of people per family Old-age index	% separated and divorced % primary school diploma or no qualification	% housing with bathtub or shower		
Genoa (72.2%)[1]	1 = 21.2%	2 = 21.2%	3 = 16.0%	4 = 13.8%	
	Index of structural dependence Old-age index % widowers/widows	% single-parent families % single-parent families with children <15 years	% married % 2-member families	% rented homes % lower secondary school	
Palermo (64.3%)[1]	1 = 28.2%	2 = 21.9%	3 = 14.2%		
	% earners from labor or capital income Old-age index Index of structural dependence	Average no. of people per family % primary school diploma or no qualification	% single-parent families with children < 15 years		
Rome (59.3%)[1]	1 = 18.6%	2 = 13.8%	3 = 9.6%	4 = 9.5%	5 = 7.7%
	% widowers/widows Index of structural dependence Old-age index % men Average no. of people per family	% primary school diploma % employed in industry	Replacement index	% separated and divorced % rented homes	% family helpers % employed in agriculture % students
Sassari (56.5%)[1]	1 = 21.8%	2 = 20.5%	3 = 14.2%		
	Average no. of people per family Average no. of people per occupied dwelling % 3-member families % married % students	% housing with drinking water % housing with kitchen	% belonging to labor force % men		
Siena (63.5%)[1]	1 = 26.4%	2 = 18.6%	3 = 18.5%		
	% widowers/widows % women Old-age index Index of structural dependence	Employment rate Activity rate	% unemployed looking for new jobs % 3-member families		
ULSS7 - Veneto (49.1%)[1]	1 = 26.5%	2 = 22.6%			
	Unemployment rate % other employment status	% housewives % married Old-age index			

[1] Total explained variance.

Tab. IIIa. SEHDI general validation.

Area	Deprivation groups	SMR - Overall mortality	Replacement index	Old-age index	Index of structural dependence	Activity rate	Employment rate	Unemployment rate
Cagliari	High deprivation	1.93	271.98	566.28	106.07	43.26	60.79	11.59
	Medium-high deprivation	1.48	265.22	372.47	61.41	49.30	59.23	12.53
	Medium deprivation	1.20	219.61	301.22	54.49	52.59	60.55	11.32
	Medium-low deprivation	0.76	206.15	242.88	50.81	54.19	59.25	12.40
	Low deprivation	0.33	127.10	100.38	40.40	60.40	63.03	10.02
	Total	**1.16**	**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***	***p<0.05 L***	***NS***	***NS***
Ferrara	High deprivation	2.25	243.49	633.07	144.78	40.02	68.52	6.99
	Medium-high deprivation	1.46	271.62	404.00	78.28	47.32	69.71	6.65
	Medium deprivation	1.07	251.50	310.70	61.97	52.94	71.61	5.41
	Medium-low deprivation	0.82	219.24	229.42	50.72	58.12	72.52	4.67
	Low deprivation	0.47	152.62	104.97	34.08	68.09	75.57	3.83
	Total	**1.20**	**236.09**	**332.27**	**70.21**	**53.28**	**71.57**	**5.49**
	Trend	***p<0.05 L***	***p<0.05 NL***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***
Florence	High deprivation	1.22	152.46	292.92	70.39	52.59	66.21	7.01
	Medium-high deprivation	1.04	167.14	230.77	64.89	52.16	68.14	5.58
	Medium deprivation	1.10	203.88	253.72	66.32	52.22	70.77	4.60
	Medium-low deprivation	1.13	262.18	274.88	64.17	53.39	72.32	4.53
	Low deprivation	1.00	271.15	273.66	54.19	57.80	74.28	4.61
	Total	**1.09**	**211.38**	**259.99**	**63.98**	**53.45**	**70.75**	**4.99**
	Trend	***p<0.05 NL***	***p<0.05 L***	***p<0.05 NL***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***
Foggia	High deprivation	1.59	185.4	383.1	71.7	41.3	52.7	8.9
	Medium-high deprivation	1.19	155.7	215.0	60.0	42.4	47.8	10.2
	Medium deprivation	0.83	139.3	135.4	53.3	44.7	45.5	11.1
	Medium-low deprivation	0.77	102.3	97.2	51.6	44.7	41.6	11.5
	Low deprivation	0.20	92.1	83.2	60.1	46.9	45.3	11.0
	Total	**.95**	**139.7**	**177.3**	**57.8**	**43.8**	**46.3**	**10.6**
	Trend	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***NS***	***NS***
Genoa	High deprivation	3.40	256.3	606.0	84.7	43.6	60.0	7.7
	Medium-high deprivation	1.10	208.0	346.4	72.8	46.2	64.9	6.6
	Medium deprivation	1.02	203.3	261.3	69.8	49.4	65.9	5.7
	Medium-low deprivation	0.85	196.7	212.7	59.3	53.4	68.7	4.9
	Low deprivation	0.79	178.4	140.6	54.2	58.6	68.9	5.4
	Total	**1.10**	**203.8**	**279.9**	**67.8**	**49.8**	**66.2**	**5.9**
	Trend	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***

L = linear trend; NL = non-linear variation; NS = not statistically significant; NA = not available. Replacement Index = [(Pop. 60-64 yrs) / (Pop. 15-19 yrs)*100]; Old-age Index = [(Pop. 65+ yrs) / (Pop. 0-14 yrs)*100]; Structural Dependency Index= [(Pop. 0-14 yrs + Pop. 65+ yrs) / (Pop. 15-64 yrs)*100]; Activity Rate = [(Work Force 15-64 yrs / Pop. 15-64 yrs) * 100]; Employment Rate = [(Employed 15+ yrs / Pop. 15+ yrs) *100]; Unemployment rate = [(Unemployed 15+ yrs / Work Force 15+ yrs) *100].

Tab. IIIb. SEHDI general validation.

Area	Deprivation groups	SMR - Overall mortality	Replacement index	Old-age index	Index of structural dependence	Activity rate	Employment rate	Unemployment rate
Palermo	High deprivation	1.02	132.62	234.06	90.61	38.70	41.12	13.24
	Medium-high deprivation	1.04	127.95	173.27	60.86	43.48	42.11	12.10
	Medium deprivation	1.02	125.02	143.57	51.31	47.43	46.48	10.71
	Medium-low deprivation	0.93	122.47	115.85	41.47	51.30	48.49	10.02
	Low deprivation	0.96	115.38	100.44	29.98	58.37	54.28	9.55
	Total	**1.00**	**124.52**	**142.80**	**50.72**	**48.16**	**46.52**	**10.82**
	Trend	***p<0.05 NL***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***
Rome	High deprivation	1.53	296.98	323.60	61.02	44.75	53.14	10.53
	Medium-high deprivation	1.23	236.64	217.12	53.37	49.69	58.20	8.17
	Medium deprivation	1.05	176.50	163.71	48.17	51.71	58.65	7.26
	Medium-low deprivation	0.88	129.21	122.97	41.94	53.82	58.23	6.35
	Low deprivation	0.67	92.96	110.51	31.74	53.29	54.89	5.46
	Total	**1.08**	**184.10**	**176.48**	**47.96**	**51.27**	**57.75**	**7.42**
	Trend	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***NS***	***p<0.05 L***
Sassari	High deprivation	NA	138.21	284.73	94.86	43.54	48.89	14.34
	Medium-high deprivation	NA	163.46	245.58	56.59	50.26	54.75	13.54
	Medium deprivation	NA	184.64	249.63	51.95	51.63	56.66	12.82
	Medium-low deprivation	NA	152.84	148.52	40.16	57.86	58.52	12.10
	Low deprivation	NA	150.81	182.59	39.86	63.15	65.78	10.06
	Total	**NA**	**172.04**	**242.04**	**57.24**	**51.56**	**56.08**	**12.88**
	Trend	***NA***	***p<0.05 NL***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***
Siena	High deprivation	1.29	189.7	524.6	70.1	61.7	83.0	7.8
	Medium-high deprivation	1.25	271.8	336.6	67.8	55.2	73.8	6.4
	Medium deprivation	0.98	249.6	317.4	65.0	53.0	72.1	3.8
	Medium-low deprivation	0.92	203.3	264.7	66.9	50.5	69.0	2.8
	Low deprivation	0.80	220.2	165.2	60.3	49.7	61.4	1.2
	Total	**1.02**	**237.3**	**317.6**	**65.9**	**53.5**	**71.9**	**4.3**
	Trend	***p<0.05 L***	***p<0.05 NL***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***	***p<0.05 L***
ULSS 7 - Veneto	High deprivation	1.02	133.8	133.5	53.8	56.1	67.9	6.2
	Medium-high deprivation	1.01	114.0	121.9	52.7	57.5	69.2	5.2
	Medium deprivation	0.97	135.1	146.1	56.2	54.0	67.5	4.9
	Medium-low deprivation	0.90	144.1	194.8	60.5	51.5	66.6	5.8
	Low deprivation	0.87	142.2	157.6	55.4	54.5	69.0	4.1
	Total	**0.96**	**131.5**	**142.1**	**55.2**	**55.0**	**68.1**	**5.1**
	Trend	***p<0.05 L***	***p<0.05 NL***	***p<0.05 L***	***NS***	***p<0.05 NL***	***NS***	***p<0.05 L***

L = linear trend; NL = non-linear variation; NS = not statistically significant; NA = not available. Replacement Index = [(Pop. 60-64 yrs) / (Pop. 15-19 yrs)*100]; Old-age Index = [(Pop. 65+ yrs) / (Pop. 0-14 yrs)*100]; Structural Dependency Index= [(Pop. 0-14 yrs + Pop. 65+ yrs) / (Pop. 15-64 yrs)*100]; Activity Rate = [(Work Force 15-64 yrs / Pop. 15-64 yrs) * 100]; Employment Rate = [(Employed 15+ yrs / Pop. 15+ yrs) *100]; Unemployment rate = [(Unemployed 15+ yrs / Work Force 15+ yrs) *100].

Tab. IV. Population distribution by SEHDI cluster.

Area	Deprivation groups	2011 resident population	%	Area	Deprivation groups	2011 resident population (2001 for Rome municipality)	%
Cagliari	High deprivation	4369	2.9	Palermo	High deprivation	17705	2.7
	Medium-high deprivation	28603	19.1		Medium-high deprivation	104476	15.9
	Medium deprivation	79276	53.0		Medium deprivation	299408	45.6
	Medium-low deprivation	35009	23.4		Medium-low deprivation	213778	32.6
	Low deprivation	2405	1.6		Low deprivation	20783	3.2
	Total	*149662*	*100.0*		*Total*	*656150*	*100.0*
Ferrara	High deprivation	14986	11.3	Rome	High deprivation	211082	8.4
	Medium-high deprivation	30682	23.1		Medium-high deprivation	602638	24.0
	Medium deprivation	49151	37.1		Medium deprivation	1016130	40.4
	Medium-low deprivation	27858	21.0		Medium-low deprivation	569461	22.7
	Low deprivation	9868	7.4		Low deprivation	112879	4.5
	Total	*132545*	*100.0*		*Total*	*2512190*	*100.0*
Florence	High deprivation	33471	9.4	Sassari	High deprivation	9486	7.7
	Medium-high deprivation	59143	16.5		Medium-high deprivation	15782	12.8
	Medium deprivation	181077	50.6		Medium deprivation	75391	60.9
	Medium-low deprivation	50414	14.1		Medium-low deprivation	13374	10.8
	Low deprivation	33849	9.5		Low deprivation	9736	7.9
	Total	*357954*	*100.0*		*Total*	*123769*	*100.0*
Foggia	High deprivation	10721	7.3	Siena	High deprivation	2599	5.0
	Medium-high deprivation	47794	32.7		Medium-high deprivation	9324	18.0
	Medium deprivation	57617	39.5		Medium deprivation	27126	52.4
	Medium-low deprivation	20288	13.9		Medium-low deprivation	9914	19.2
	Low deprivation	9591	6.6		Low deprivation	2762	5.3
	Total	*146011*	*100.0*		*Total*	*51725*	*100.0*
Genoa	High deprivation	17380	3.0	ULSS 7 - Veneto	High deprivation	19016	8.8
	Medium-high deprivation	168228	28.7		Medium-high deprivation	49180	22.7
	Medium deprivation	268861	45.9		Medium deprivation	99721	46.1
	Medium-low deprivation	120169	20.5		Medium-low deprivation	34428	15.9
	Low deprivation	11542	2.0		Low deprivation	14072	6.5
	Total	*586180*	*100.0*		*Total*	*216417*	*100.0*

From a public health perspective, these results are very relevant, as they enable interventions of health promotion and prevention to be oriented on the basis of the characteristics that define the deprivation groups.

However, there are two limits to this procedure. The first is the potential ecological bias, albeit reduced owing to the small dimensions of the Italian CTs [2, 6]. Indeed, studies that apply synthetic multi-factorial descriptions of small geographical areas to single individuals must be evaluated in the light of good knowledge of the areas considered, in order to avoid mis-attribution of peculiarities and, consequently, any misdirected health and social policy. From this point of view, it must be remembered that local indicators, such these, are tools useful only to local policy-makers, who should have a good knowledge of the area they administer.

The second limit is more of a characteristic of these indexes than a flaw: in interpreting the territorial descrip-

tion yielded by this method, it must be borne in mind that the concept of deprivation extends to social and health aspects, and does not only concern mere material deprivation [4, 7-9]. This implies that the interpretation must consider aspects linked to the social support and cultural resources that people can count on in order to understand messages, specifically prevention messages, to adopt good practices and correct lifestyles, early terapeutic actions in charge etc.
Bearing in mind these two limitations can improve the role of these local indices in guiding interventions and using resources more efficiently.

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Conflict of interest statement

None declared.

Authors' contributions

RL developed method, data organization, quality check and analyses. MV performed text revision and references. Both the authors contributed to the text writing.

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