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ORIGINAL ARTICLE

The role of individual characteristics and municipalities in social inequalities in perceived health (Italy, 2010–2012): a multilevel study

Simone Sarti[1] · F. Biolcati-Rinaldi[1] · A. Vitalini[2]

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Abstract

Backgrounds The empirical evidence shows discordant results regarding the role of local contexts on individual health. This article considers the role of the municipal socio-economic contexts on self-rated health in Italy, taking into account some individual variables.

Methods Multilevel model software (MlwiN) is used to fit multilevel linear regression models of perceived health. Individual data are from the Italian surveys on "Aspects of Daily Life" 2010, 2011 and 2012, collected by the Italian National Institute of Statistics (Istat). In addition, municipality-level social, demographic and economic characteristics are from the 2011 Census and the database "Atlas of Italian Municipalities" (Istat).

Results The main findings of this study confirm that, controlling for age and gender at the individual level, poor health is influenced by socio-economic positions: lower education, not working or looking for employment and disadvantaged family social class predict higher perceived health. The individual level explains the 70.1% heterogeneity in self-assessed health, the family level 25.6% and the municipality level only 4.3%. The additional influence of the socio-economic context is, conversely, of little substantive importance.

Conclusions Finally, by showing that variability in health relates mainly to individual characteristics, this study suggests that intervention to mitigate social inequalities in health should focus on structural factors, such as education and the labour market.

Keywords Italy · Municipalities · Perceived health · Socio-economic context · Ecological models · Inequalities in health

Introduction

The health of the population is an issue of critical importance in human societies that affects the cultural, political and economic spheres. Good health allows individuals to reproduce not only biologically but also in a cultural sense through the development of stable and well-fitting social identities (Haslam et al. 2009). Improving the health of all human beings is one of the most important goals declared by international organizations (Marmot 2015). The economic burden of protecting and promoting health in modern societies is an important aspect of public and private expenditure. For example, in Western countries, approximately 10 % of the GDP is devoted to health, and this expenditure is steadily increasing (World Bank 2017).

When health is associated with social conditions that are attributable, for any reason, to forms of inequality, then one can speak of social inequalities in health. From this perspective, variability in health is seen as reflecting structural disadvantages with regard to social organization, such as the stratification of the educational system or the segmentation of the labour market (Sarti and Zella 2016; Phelan et al. 2010; Mackenbach et al. 2008; Marmot 2015; Marmot 2005).

The study of social inequalities in health recognizes that the relationship between social conditions and health may be affected by several confounding variables that may eliminate or reduce the role of social conditions. These variables can be classified into two main interacting groups: biological and contextual. Moreover, we can add individualized or idiosyncratic behaviours (self-determined on the basis of free choices) and stochastic effects. However, these factors remain part of the unexplained variance within the statistical models employed.

✉ Simone Sarti
simone.sarti@unimi.it

[1] Department of Social and Political Sciences, University of Milan, Via Conservatorio, 7, 20122 Milan, Italy

[2] ISTAT Sede territoriale per la Lombardia, ISTAT–National Institute of Statistics, 20124 Rome, Italy

The former concerns the genetic characteristics of individuals; their genetic heritage may inherently give them higher propensities for specific diseases or may increase their likelihood of engaging in unhealthy behaviours (such as tobacco dependency). No less important in determining health are the ecological characteristics of an area, which affect all people who reside in or belong to a certain context regardless of their individual characteristics but that are absent (or different) for subjects who do not belong to that context.

Therefore, it is not sufficient to describe inequalities in health by identifying an association between variables that are proxies for social resources (typically, educational attainment, employment status or social class) and health status. It is also necessary to control some key biological variables. In the absence of information on subjects' genetic heritage, researchers generally use gender and chronological age (in particular, the latter is the most important determinant of health status: Ross and Wu 1996). However, when available, it is necessary to also consider the territorial area where individuals live although the role of local contexts is decidedly complex and uncertain. Several epidemiological studies show that the presence of pollution or adverse weather conditions (such as atmospheric particulate matter or heat waves) is related to worse health conditions (Bell et al. 2013). In contrast, the effects of social contextual characteristics are contradictory: for example, some studies show that greater inequality generally leads to poorer health, whereas others question these results, which may be a function of taking the nation as the reference (Wilkinson and Pickett 2009; Tremblay et al. 2002; Subramian et al. 2001; Pickett and Pearl 2001).

The most innovative aspect of this study is that we are able to account for the municipality of the subjects, a very detailed ecological level. This information is accessible only through the activation of a research protocol with the Italian National Institute of Statistics (Istat). Thus, we applied appropriate multivariate statistical models (multilevel) to investigate the association between social conditions and individuals' health net of some confounding factors, including the area of residence at the municipal level (Goldstein 2011). We were interested in studying the relationship between health and social conditions (using the individual's socio-economic resources as a proxy) and in controlling the confounding role of demographic characteristics and ecological contexts (at the level of municipality of residence). Our research questions were the following: does the geographical heterogeneity of health status depend on compositional effects? Does the association between health status and individual socio-economic characteristics remain stable when controlling for different geographical areas?

Data and method

The data used in this analysis came from the Italian "Aspects of Daily Life" survey conducted by the Italian National Institute of Statistics (Istat, 2006). The data referred to the years 2010, 2011 and 2012. The three editions of the survey were grouped to achieve an adequate sample size for analysis.

Each year, the survey selects approximately 50,000 subjects and 20,000 households according to a multi-stage sampling design, with units of the first stage represented by municipalities. Within each sampled municipality, some households are extracted in a systematic way from the registry lists of residents (excluding those who live in convents, communities and nursing homes). All the residents living in a sampled household are interviewed. The survey sample is representative of the population at the sub-national (Regional/NUTS-2) level. Figure 1 shows the municipalities considered in the sample.

Information at the municipal level was extracted from the data of the 2011 Population Census (available in the data warehouse I.Stat) and from the Istat information system "Atlas of Italian Municipalities".

In this study, we performed a sample selection to include people aged between 27 and 69 years old. This choice was made for substantive reasons: to investigate individuals who had finished their studies and to avoid the introduction into the analysis of distortions due to the mortality effect (Willson et al. 2007).

The data were organized into three hierarchical levels: individuals, families and municipalities, which included 83,375, 47,102 and 1758 units, respectively. The sample included, on average, 1.8 respondents per household and 47.4 per municipality.

Dependent variable

Self-perceived health was the dependent variable used in the analysis. It was selected as the outcome variable because it synthesizes different aspects of health, all sensitive to potential inequalities.

In the "Aspects of Daily Life" survey, perceived health is measured by asking the interviewee the following question (based on the WHO question): "How is your health in general?" The respondent can choose from five answering modes the one most suited to his condition: very good, good, neither good nor bad, bad and very bad.

Despite its simplicity, the self-reported health condition, measured with wording similar to that used in the "Aspects of Daily Life" survey, has been found at both the international and national levels to be not only a good indicator of actual health conditions but also a good predictor of mortality in subsequent years (Jylhä 2009; Egidi and Spizzichino 2006; Fayers and Sprangers, 2002).

The dependent variable showed a strong asymmetric distribution (see Table 1). Different types of transformations (e.g., logarithmic, square root) were applied to the dependent variable to normalize its asymmetric distribution. Because the various transformations produced similar results, we decided to use the original variable.

Fig. 1 Municipalities considered in the sample

Independent variables

At the individual level of analysis, we considered demographic and social variables: gender, age, education and employment status. Age and education were included in the models as continuous and categorical variables to test the assumption that their impact on perceived health was not linear through the life course. The ordinal variable—educational level—was transformed into a metric variable by assigning to each level of formal education the number of school years necessary to achieve the qualification. However, in the final models, these variables were included as continuous variables centred on the average because, in both cases, the observed effects on health approximated a straight line.

We also evaluated the health impact of family social class. This variable was constructed by initially associating a social class to each member on the basis of the last occupation declared, in accordance with traditional procedures used in class sociology (Erikson and Goldthorpe 1992). Entrepreneurs, managers, management-level employees, executives and professionals were coded as "bourgeoisie", office workers as "white-collar middle class", self-employed workers and assistants as "self-employed", and foremen, labourers, apprentices, cooperative members, home workers and occasional project workers as "working class".

Second, we used a dominance criterion by assigning to each family the highest class present among its members according to the usual hierarchy: bourgeoisie, white-collar middle class, lower middle class (self-employed) or working class. Subjects who did not fall into any of the above-mentioned categories were included in a residual category, "other".

The use of family social class combined with the individual characteristics should be considered an element of originality in this research. The decision to use this information was based on the idea that health inequalities depend not only on strictly personal resources but also on family resources (i.e., economic, cognitive, relational), which the individual shares with other members.

Table 1 Percentage distributions of the variables gender, age, qualification, employment, social class and self-perceived health, and average age and years of formal education

	Percentage
Gender	
Males	48.9
Females	51.1
Age	
27–39 years	28.6
40–49 years	27.1
50–59 years	23.6
60–69 years	20.7
Average age	47.7
Educational level	
Primary	14.1
Lower secondary	40.1
Upper secondary	31.8
University	14.1
Average of school years	10.6
Employment status	
Employed	56.6
Looking for employment	10.0
Not working	33.4
Family social class	
Bourgeoisie	21.6
White-collar middle class	34.6
Self-employed	13.4
Working class	27.3
Other	3.1
Self-perceived health	
1. Very bad	0.6
2. Bad	3.5
3. Neither good nor bad	24.8
4. Good	56.5
5. Very good	14.7
N	83,375

In the regression models, we also considered the number of family members and a few different types of families. The inclusion of these additional covariates was not statistically significant and did not change the coefficients of the other covariates already included in the model.

See Table 1 for the distributions of the variables considered at the individual and household levels in the following multivariate models.

In the case of a significant presence of spatial variability in the residual of perceived health, we considered the possible inclusion of several covariates at the municipal level: latitude, type of municipality ("inner mountain", "mountain coast", "hill internal", "coastal hill", "plain"), population density, population density per equivalent inhabitant (conventionally defined as the amount of biodegradable pollutants produced and entered into the sewer during 1 day by an inhabitant permanently living in a place).

Analysis techniques

In the analysis, we used multilevel regression models under the assumption that health outcomes are simultaneously affected by the characteristics of individuals and by the environments in which they live. In the literature, multilevel models are commonly used to analyze data with hierarchical structures in which the individual units are included in groups of increasingly wide extent.

Multilevel regression models are particularly well suited to the hierarchical structure of the sampling in the "Aspects of Daily Life" survey (Istat, 2006). In fact, respondents are grouped on three levels: individual, family and municipality. The main advantage of multilevel regression models in the context of this article is that they distinguish among the effects of individual, family and municipality characteristics and can be used to test the possible effects of interaction among the levels. A comprehensive description of the advantages of multilevel statistical models compared with traditional ones is provided in Goldstein (2011).

In this article, we present the coefficient estimates of multilevel linear regressions calculated using the MlwiN software (the analyses were also repeated with STATA 12). The dependent variable—perceived health—was regarded as a proxy for a variable metric, assigning the values 1 to the answer mode "very bad", 2 to "bad", 3 to "neither good nor bad", 4 to "good" and 5 to "very good".

Multilevel model building strategies can be either top-down or bottom-up. We adopted a bottom-up approach in which the different models are developed incrementally (Hox 2010). The first model, normally called the "null", "empty" or "only with the intercept" model, does not contain independent variables and makes it possible to split the variability of responses among different levels of analysis. To this basic model are added covariates at different levels (individual, family and municipal) to evaluate the specific contribution to the prediction of perceived health.

The models are defined by the following basic equations:

$$Y_{ijk} \sim N(X\mathrm{B}, \Omega)$$

$$Y_{ijk} = \beta_{0ijk} + \sum_{m=1}^{M} \beta_m X_{mijk} + \sum_{n=M+1}^{N} \beta_n X_{njk} + \sum_{p=N+1}^{P} \beta_p X_{pk}$$

$$\beta_{0ijk} = \beta_0 + e_{0ijk} + u_{0jk} + v_{0k},$$

where Y is the dependent variable, self-assessed health; X_{mijk} are the independent variables at the individual level, X_{njk} are the independent variables at the familial level, and X_{pk} are the variables at the municipal level; i represents individuals, f the

familial context and *k* the municipal context. The letters *v*, *u* and *e* denote, respectively, the residuals at the third, second and first levels. Beta coefficients of the regression are the values to estimate.

In the analysis, we used unweighted cases because the use of weights does not affect the substantive results and introduces unnecessary complexity into the calculations. Piombo (2013) reached the same conclusion when using data from the "Health conditions and recourse to health services-2004–2005" survey conducted by the Italian National Statistics Institute (Istat, 2006). That survey has a structure very similar to "Aspects of Daily Life".

In addition, due to awareness of the statistical problems associated with the use of an ordinal variable as a proxy for a metric variable, we calculated multilevel, multinomial regressions with the same independent variables but with the dependent variable—perceived health—introduced as ordinal. Because the results are substantially the same in both types of models, the use of multilevel linear regression, although it forces the ordinal nature of the dependent variable, was preferred over the multinomial model because it was easier to calculate and explain.

To assess the internal validity (inconsistency of the coefficients, violation of assumptions on the distribution of residuals at different levels, model mis-specification), we performed several diagnostic checks on the final model. In particular,

- we tested a random slope model to investigate the intra-level variability;
- we added some interaction effects between covariates and cross-level interactions looking for any model mis-specification;
- we tested the relationship between residuals and predicted values looking for any patterns;
- we re-estimated the final model by separately considering the data of the individual years (2010, 2011, 2012);
- we re-estimated the final model on 100 subsamples in which the number of respondents of the larger municipalities was set at one hundred.

All diagnostic checks confirmed the internal validity of the final model presented in the article.

Results

Table 2 shows the main results of the analyses performed. The aim of this article is to contribute to the debate on the individual rather than the contextual (municipality) nature of health inequalities for the Italian case. A multi-level data set was produced to distinguish individual effects from contextual ones. It should be noted that a household survey (Istat "Aspects of Daily Life") was selected. This data set makes it possible to isolate the family level beyond the individual and contextual levels.

The answer to the main research question was provided by model 1.0 (see Table 2). This model contained only the intercept and allowed estimation of the proportion of variance at the various levels. More than two-thirds of the variance of the variable on perceived health came from the individual level (70.1%), and approximately one-fourth came from the family level (25.6%). Therefore, the proportion of variance attributable to the contextual level (municipality) was minimal at 4.3%. These results confirm the importance of the individual and household levels to the detriment of the municipality. Health inequalities thus seem to be due to compositional effects rather than to genuine contextual effects (related to the environmental and demographic quality of the various municipalities). At this point, it was of little use to search for contextual variables at the municipal level that would be able to explain territorial heterogeneity because there was very little of this type of heterogeneity. We therefore decided not to include the ecological variables selected at the beginning, such as altitude, latitude and urbanization, in the models (see Sect. 3.2).

In later models, a number of independent variables were considered to account for variances at different levels. Referring to model 1.3 in Table 2, we see that included at the individual level are three variables that have a significant effect on the dependent variable. Males have better perceived health than females by almost one-tenth of a point (0.09). Note that the indicator scale ranges from 1 to 5, but one-tenth of a point is certainly an appreciable effect because its distribution is highly concentrated around the mean. Age and education have effects of similar magnitude but of opposite signs: perceived health increases with decreasing age and increasing years of education. The effect is −0.02 for age and 0.02 for schooling. If 10 years are considered rather than a single one, the effect is equal to approximately two-tenths of a point. At the household level, social class is included. The effects are significant and confirm the usual hierarchy. Compared with the category of the working class, individuals belonging to middle-class families have a competitive advantage of one-tenth of a point (0.11), and the effect is similar (slightly more than half a point) for the white-collar middle class (0.07) and the petty bourgeoisie (0.06). Finally, the "other" category has a disadvantage of approximately half a point (0.05), again compared with the working class.

Employment status at the individual level is added in model 1.4. Individuals seeking employment and those who are inactive declare perceived health less than one-tenth of a point below that of employed persons (regression coefficients are −0.09 and −0.11, respectively). The inclusion of this variable leads to a contraction of the effects of gender and working class.

Table 2 Multilevel regression model of self-perceived health (1–5) and the variation partition coefficients ($N = 83.375$)

	Model 1.0 ***Beta*** ***(std. error)***	VPC %	***Model 1.1*** ***Beta*** ***(std. error)***	VPC %	***Model 1.2*** ***Beta*** ***(std. error)***	VPC %	***Model 1.3*** ***Beta*** ***(std. error)***	VPC %	***Model 1.4*** ***Beta*** ***(std. error)***	VPC %
Intercept[+]	3.755 (0.005)		3.754 (0.005)		3.763 (0.005)		3.709 (0.007)		3.772 (0.008)	
Individual level										
Gender (male)			0.093 (0.004)		0.092 (0.004)		0.091 (0.004)		0.065 (0.004)	
Age (27–69 years) centred			−0.021 (0.000)		−0.019 (0.000)		−0.019 (0.000)		−0.018 (0.000)	
Years of school attendance (0–21) centred					0.024 (0.001)		0.020 (0.001)		0.017 (0.001)	
Employment status										
Employed									0[a]	
Looking for employment									−0.085 (0.008)	
Not working									−0.112 (0.006)	
Family level										
Family social class										
Bourgeoisie							0.121 (0.009)		0.111 (0.009)	
White-collar middle class							0.065 (0.007)		0.055 (0.007)	
Self-employed							0.063 (0.009)		0.054 (0.009)	
Other							−0.048 (0.015)		−0.008 (0.016)	
Working class							0[a]		0[a]	
Random variance:										
Individual variance	0.389	70.1%	0.337	68.9%	0.336	70.1%	0.334	70.2%	0.334	70.5%
Household variance	0.142	25.6%	0.128	26.2%	0.120	25.1%	0.119	24.9%	0.118	24.9%
Municipality variance	0.024	4.3%	0.024	4.9%	0.023	4.8%	0.023	4.8%	0.022	4.6%
IGLS deviance (−2 Ln(L))	182,365		171,185		169,817		169,566		169,190	

[+] *Random parameter*

Note: To test the statistical significance of a fixed parameter, a parametric test with z normal distribution can be used. The value of the statistic z for a given coefficient is the ratio between the value of the coefficient and the standard error (written in parentheses in the table). Shaded cells contain coefficients not statistically significant at the 0.05 level. To compare the models, the LR test (likelihood ratio) can be used. The value of the LR statistic is given by the difference, in absolute value, of the IGLS deviance of the two models to be tested. The LR test statistic has a chi-square distribution with degrees of freedom equal to the number of estimated parameters in the more complex model

Conclusions and discussion

The empirical evidence shows discordant results regarding the role of local contexts on health (Wilkinson and Pickett 2009; Tremblay et al. 2002; Subramian et al. 2001; Pickett and Pearl 2001). In fact, the definition of the territorial context seems to change the outcome of studies so that the smaller the size of the context used (ideally up to the neighbourhood or block level), the greater is the probative force of the model under consideration. Large contexts may regress toward the mean and not show significant effects, whereas the micro-mapping of contextual conditions can eliminate this problem. Another problem is the conceptualization and operationalization of possible pathways connecting the ecological level to health. There are different pathways through which area characteristics may directly and indirectly influence individual health, and simple aggregated variables cannot capture these effects (Cummins et al. 2005).

In this study, we have addressed the issue of health inequalities in Italy in recent years where the literature on this subject is limited. We mention here the most recent studies by Marinacci et al. (2010), Lucchini et al. (2009) and the work of Piombo (2013). All of these studies agree that heterogeneity in health is mainly related to individual effects. In other words, after evaluating health status by gender, age, educational level and employment status, health heterogeneity due to the context remains extremely modest. This means that self-assessed health seems to be determined by individual characteristics and thus by compositional effects, not by the characteristics of the area. In other words, if, in certain geographical areas, the population is worse off in terms of health, this is because the individual social conditions of that population are worse on average. However, the above studies employ regions as contextual units (Marinacci et al. 2010; Lucchini et al. 2009) or they employ a limited number of municipalities (Piombo 2013). Accordingly, the use of a more detailed ecological level might yield very different results, as found in some studies (Schaefer et al. 2010; Diez Roux 2001; Marinacci et al. 2004).

Specifically, here we have analyzed whether health inequalities are more influenced by individual characteristics or by geographical location, considering the municipality level (an ecological level never tested before).

Our results show that heterogeneity in health levels seems more linked to compositional effects than to the local context, according to other studies (Piombo, 2013; Marinacci et al. 2010). The strong variability of perceived health is thus partially explained by age, gender, level of education, family social class and employment status. Local variations are of little substantive importance, although they are statistically

significant. To summarize the results in one sentence,, "It's who you are and what you do, not where you live, that has a greater influence on the state of your health" (Tremblay et al. 2002, 1). From a policy perspective, if we consider social conditions as fundamental causes of worse health (Phelan et al. 2010), our results suggest that interventions to mitigate social inequalities in health should focus on traditional structural factors, such as those related to stratification in the educational system and the connected segmentation of the labour market and social classes (Goldthorpe 2009).

The results of this study should nevertheless be read in light of three important limitations. First, area effects might have arisen if we considered smaller contexts. We considered municipalities, which have homogeneous socio-economic characteristics throughout their territories. In any case, in large municipalities (e.g., large cities), it is possible that the various socio-economic aspects are heterogeneous. A study of the factors influencing the level of health that considers the census sections (areas for which data will be available in the next year) could lead to conclusions different from those presented in this article.

Second, the use of multilevel models is a practice established in the literature to separately assess the effects of individual, family and contextual characteristics on the level of health (Schaefer-McDaniel et al. 2010). However, this approach does not make it possible to clarify the relationship between individual and contextual effects. In multilevel regression models, individual and family variables are usually added to the "null model". If the variability at the contextual level is not statistically significant, it can be stated that the differences in terms of health are due to composition rather than to contextual effects. This conclusion, although not in contradiction with the data, may not be correct. The individual variables introduced could be intervening variables. In other words, the individual or family attributes may themselves be shaped by the characteristics of the area in which people live. For example, health is influenced by social class, but the latter may be affected by the characteristics of the local labour market. For a critical examination of this issue and of the problems related to the study of compositional and contextual effects with the use of regression models in general, see Macintyre et al. (2002).

Finally, with reference to health, a third limitation should be considered: the issue of the unobserved heterogeneity related to the genetic heritage of individuals becomes particularly relevant. Genetic inheritance certainly has individual variability, which, however, is largely due to family heredity. It was not the aim of this study to estimate the genetic component at the individual or family level, but this is an aspect to consider in future studies.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Italian data were collected by ISTAT-National Institute of Statistics (Italy) according to the international standards and the Italian legislation (art. 9 del d.lgs. n. 322/89; d.lgs. n. 196/03). More information at: http://www.istat.it/en/privacy

Specific information on interviewees' municipalities in "Multiscopo" surveys was used under a particular agreement between the University of Milan and ISTAT (Sede Regionale per la Lombardia).

Informed consent Informed consent was obtained from all individual participants included in the study before taking part.

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