

Magnitude and shape of income inequalities in hospitalization for all causes in Italy

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Abstract

Background: Few of the studies that have evaluated the impact of income on health and health services utilisation have been conducted in southern Europe and have focused on the shape of the relationship. This study aimed at evaluating the hospitalisation gradient by small area income and to analyse its shape, with data from four large Italian cities.

Methods: Census tract (median 260 residents) median per capita income was computed through record linkage between 1998 national tax and local population registries in the cities of Rome, Turin, Milan and Bologna (total population of approximately 5.5 million). Census tract median income was assigned to general acute hospital discharges in the period 1997-2000 among residents in the cities, on the basis of the patient's residence. Within each stratum defined by gender and age group (0-64, 65+), standardised hospital discharge rates were computed for quantiles of census tract median income. A segmented non-linear model was fitted to discharge rates across percentiles, as function of median value of census tract median income in each percentile.

Results: This study showed an inverse gradient in hospitalizations with increasing small area income. A less marked decrease in the standardised discharge rates was shown above approximately €12,000 census tract median per capita income, for both males and females and for the two age-groups considered.

Conclusions: Small area income seems to have a strong association with hospitalisation, acting through a differential occurrence of diseases and/or access to health services. Among the wealthiest persons, the results suggest the diminishing return of health and/or appropriateness of health care with increasing income.

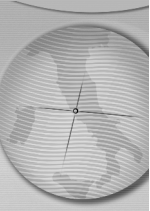
Key words: income, hospitalisation, inequalities, socio-economic factors, Italy

Introduction

In the past 15 years, numerous studies have provided empirical evidence of an association between greater income and lower mortality [1-6], lower morbidity and better perceived health [1,7-9]. The relationship between income and health not only expresses the direct influence of income on the material conditions that can affect health but it also indirectly reflects the capacity of income to compensate for social and environmental stressors [10]. Fewer and less consistent data are available on income inequalities in the use of health services [11, 12], which are more influenced by the specific healthcare systems and policies.

Few of the studies that have evaluated the relationship, at the individual level, between income and health have been conducted in southern Europe [13, 14], probably because, given issues related to confidentiality, it is difficult to gain access to high-quality data on income which are linkable to health data. In the attempt to overcome this problem, small-area indicators of income or economic poverty, attributed to area-coded health data, have been proven to produce valid and robust estimates of socio-economic inequalities in the health of individuals [15, 16].

Regarding income distribution, there has been an intense debate surrounding the causal mechanisms of its relationship to health. One



explanation for this relationship is related to the specific shape of the relationship between income and health at the individual level [17-19]. In particular, it is supposed that the effect of income distribution is a statistical artefact, explained by the way in which income affects health at the individual level [20-21]. It has been observed that the decrease in mortality becomes less marked with increasing income, following a non-linear relationship. This has led to the hypothesis that, if comparing countries with equal mean incomes, the country with a greater income concentration will have a higher mortality: in this country, the diminish return of health with increasing income implicates that health advantages of persons with a higher income level do not compensate for the disadvantages of the higher proportion of poorer persons. Nonetheless, the diminishing return hypothesis has been fertile ground for contrasting empirical evidence on mortality [22, 23] and different health measures, also by age and gender [8, 24], yet it has not been extensively studied with regard to health services utilization.

The objective of the present study was to evaluate the extent and the shape of the association between small-area income and hospitalization for all causes (by gender and age-class) among a population consisting of persons residing in four large Italian cities.

Methods

The study was conducted among the populations of the cities of Rome (central Italy, approximately 2.8 million residents); Bologna (central Italy, approximately 400,000 residents); Turin (northwest Italy, approximately 900,000 residents); and Milan (northwest Italy, approximately 1.4 million residents).

Indicators of income

Aggregated indicators of income were defined for the census tracts of the participating cities (geographic units with a median of 260 residents, 1st - 3rd quartile: 122-441 residents). The indicators were calculated by extracting, from the municipality population registries, individual records of persons who were residents on 1 January 1998. These records contain, in addition to the individual's date and place of birth, gender, and fiscal code, the family code and the census tract of residence. The fiscal code was then used to perform record linkage with the declarations of income for the 1998 fiscal year, recorded at the Tax Register of the Ministry of Finance. Net family income was calculated by totalling the incomes of

the declaring family members, excluding taxes. This procedure attributed income data to 89.43% of resident families in Bologna, 85.63% in Turin, 79.56% in Milan, and 74.79% in Rome. The net family income was then divided by the number of family members, taking into consideration family size, using the Carbonaro equivalence scale [25], which produced the equivalised disposable per capita income. For each census tract, the Census Tract Median per capita Income (CTMI) was calculated. This procedure was performed by the national institute which is authorized to handle individual data on income, and which provided the CTMIs to the authors of the present study.

Total 16,557 census tracts were first considered. We excluded the census tracts with a CTMI greater than or equal to €103.29 (one census tract in Milan and one in Bologna) and those tracts for which the information source was not able to accurately estimate the indicator; in particular, the tracts in which more than 75% of the families had no declared income (1.5% of the tracts in Rome, 0.5% in Bologna, and 1.6% in Milan). The analysis included total 16,370 census tracts.

Selection of hospital discharges

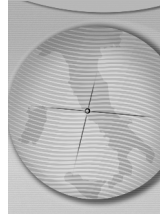
From the archives of hospital discharges in the region of each participating city, we selected all acute ordinary hospital discharges between 1 January 1997 and 31 December 2000 for persons who were residents on 1 January of each year in the above-specified period. Day hospital discharges, hospitalizations in the first 15 days of life, admissions for rehabilitation and admissions in regions other than the one of residence have been excluded.

For each hospitalization, we attributed the census tract of residence of the patient in the year of discharge (not present for 0.23% of the hospitalizations in Turin, 3% in Rome, and 0.1% in Milan). The CTMI in 1998 was then assigned.

The analysis included those hospitalizations for which complete information was available for the patient's date of birth, gender, and census tract of residence, as long as it did not meet the above-reported exclusion criteria. A total of 1,669,018 discharges were analyzed in the 0-64-year age-group (740,579 males and 928,439 females) and 1,215,686 discharges in persons 65 years of age and older (562,488 males and 653,198 females).

Statistical analysis

The analyses were stratified by gender and age at discharge (0-64 years and 65 years and older). The census tracts were grouped according to CTMI quantiles: the groups were obtained from



the pool of census tracts of the four cities (not excluded according to the above described criteria), with an equal number of residents in each group. For each census-tract group, the mean annual hospitalization rates were calculated by considering the ratio of discharges to the sum of the population counts in the four-year period 1997-2000. The hospitalization rates were standardized by age at discharge using a direct method and considering, as standard, the 1998 total Italian population by five-year age groups.

The census tracts were first grouped according to CTMI quintiles. The hospitalization rates for the lowest quintile were then compared to those for the highest quintile, through relative risks and confidence intervals.

The census tracts were then grouped according to CTMI percentiles and the hospitalization rate was calculated for each group. These rates were then plotted by the median of the CTMIs in each group. Based on the plots, the discharge rates of 0-64-year-old individuals were modelled as a function of the median value of the CTMIs of each percentile, with two linear segments, connected at an estimated value [26]. The model was as follows:

$$\text{rate}_i = \alpha + b1 * x_i + b2 * (x_i - x1)_+ \text{ for percentile } i = 1, 2 \dots 100 \quad (1)$$

where x_i = median value of CTMIs in the i^{th} percentile of the CTMIs

$$\text{and } (x_i - x1)_+ = \begin{cases} x_i - x1 & \text{if } x_i - x1 > 0 \\ 0 & \text{otherwise} \end{cases}$$

and then denoting $\beta1 = b1$ and $\beta2 = \beta1 + b2$.

For persons 65 years of age and older, the graphical examination revealed that the hospitalization rate in the first percentile was lower than the rates in some of the subsequent percentiles: to reduce the influence of this value on the parameters estimate, the hospitalization rates among the persons belonging to this age group were modelled with three linear segments,

$$\text{rate}_i = \alpha + b0 * x_i + b1 * (x_i - x0)_+ + b2 * (x_i - x1)_+ \text{ for percentile } i = 1, 2 \dots 100 \quad (2)$$

where x_i = median value of CTMIs in the i^{th} percentile of the CTMIs

$$\text{and } (x_i - x1)_+ = \begin{cases} x_i - x1 & \text{if } x_i - x1 > 0 \\ 0 & \text{otherwise} \end{cases}$$

and then denoting $\beta0 = b0$, $\beta1 = \beta0 + b1$, and $\beta2 = \beta1 + b2$.

connected at two distinct estimated values, as follows:

The unknown parameters α , $x1$, $b1$, $b2$, and, for persons 65 years of age and older, $x0$ and $b0$, were estimated using iterative least squares method [27, 28]. The estimates for the parameters α , $x1$, $\beta1$, $\beta2$, and, for persons 65 years of age and older, $\beta0$ and $x0$, are reported with asymptotic confidence intervals.

The analyses were performed using SAS software (version 8.2) [29].

Results

The standardized mean annual hospital discharge rates was highest in the first CTMI quintile and consistently decreased with the successive quintiles, for both genders and for both age groups (Table 1), with a significantly higher risk of hospitalization in the first quintile, compared to the last quintile. The relative risk was slightly higher in the 0-64-year age group (compared to the older group) and among men (compared to same-age women). These results are consistent with those produced by the graphical examination (Figure 1), with the exception of the rate observed in the first percentile, which, among persons 65+ years, is likely to be lower than the rates in some of the successive percentiles. The shape of the relationship between area income and hospital discharges appears to be curvilinear, especially in the 0-64-year age-group (Figure 1a and 1b) and among older men (Figure 1c).

Among persons aged 0-64 years, the results of the models show that hospitalization rates significantly decrease with increasing income (Table 2), with a change in this decrease within the range of the median values of CTMIs across their percentiles; the threshold appears to be higher, though not significantly, among females, compared to males. In the second segment of both models, the slope is significantly less pronounced than that estimated in the first segment. For both genders, the hospital discharges decreased by a mean of approximately 1 hospitalization per 1,000 residents with each €100 increment in the median area income, when this was not greater than €12,448 annually for men and €12,814 annually for women; for higher area incomes, the hospitalizations decreased by a mean of approximately 0.20 per 1,000 residents, for both genders.

Among persons with 65 years of age or older, the first estimated segment of the models regarded the first two percentiles, showing increasing hospitalization rates with increasing income for very low CTMIs (up to approximately €8,300). In

Table 1. Annual hospital discharge standardized rates (per 1,000 residents) per quintile of Census Tract Median Income (CTMI).

Quintile	0-64 years				65 years and older			
	Men		Women		Men		Women	
	<i>n.hosp.</i> (<i>crude rate</i>)	<i>Std. rate</i>	<i>n.hosp.</i> (<i>crude rate</i>)	<i>Std. rate</i>	<i>n.hosp.</i> (<i>crude rate</i>)	<i>Std. rate</i>	<i>n.hosp.</i> (<i>crude rate</i>)	<i>Std. rate</i>
<i>I</i>	186,202 (107.64)	107.70	217,620 (129.85)	126.29	125,219 (394.35)	406.21	156,255 (291.68)	282.72
<i>II</i>	156,031 (91.67)	89.52	195,414 (114.38)	107.20	119,578 (354.62)	354.20	135,659 (264.82)	251.15
<i>III</i>	142,062 (85.33)	82.22	181,506 (106.55)	99.83	116,967 (334.28)	338.73	134,568 (249.90)	240.61
<i>IV</i>	135,957 (80.81)	76.60	173,883 (99.47)	93.01	103,818 (316.68)	316.50	117,654 (236.26)	224.19
<i>V</i>	120,327 (72.39)	65.67	160,016 (90.58)	81.54	96,906 (282.73)	266.81	109,062 (216.34)	193.83
<i>RR (I vs. V)</i>		1.64		1.55		1.52		1.46
<i>IC95%</i>		1.63-1.65		1.54-1.56		1.51-1.54		1.45-1.47

the other CTMI percentiles, the models showed an inverse relationship between the hospitalization rate and area income, characterized by two distinct linear segments, whose respective slopes were significantly different between them. For median area incomes between €8,400 and €12,000, among men 65 years of age and older, there was a decrease of 3 hospitalizations per 1,000 residents for every €100 increment in the median area income; this decrease was significantly greater than that among women (i.e., fewer than 2 hospitalizations per 1,000). For annual incomes greater than approximately €12,000, with no significant difference by gender in this threshold, the hospital discharges decreased by fewer than 1 hospitalization per 1,000 residents per €100 increment in income, with no significant differences between men and women.

Figure 2 shows the observed and model-predicted hospitalization rates. The proportion of variance of the observed rates, across CTMI percentiles, explained by the models was significant ($p < 0.0001$) for all of the gender and age-specific models.

Discussion

The results of this study show an inverse

gradient in general hospitalizations with increasing small area income among residents in four large Italian cities at the end of the 1990s. The risk of hospitalization was consistently higher among persons with lower area income, for both males and females and for the two age-groups considered. These results should be interpreted with caution, given the nature of the health outcome analyzed and the many possible mechanisms underlying an income gradient in hospitalization. For example, if the risk of hospitalization, given a defined health condition, is assumed to be constant by income level, the hospitalisation rate can be a valid indicator of the health status of a population, and a measure that can be used as an alternative or complement to mortality (which is a function of not only the incidence of pathologies but also of the offer of, access to, and quality of healthcare) in the analysis of the relationship between income and health. Nonetheless, the relationship between hospitalization and income cannot be directly considered as a valid estimate of the income gradient in the incidence of diseases; this would entail making the further assumption of homogeneity in the duration of pathologies. However, the probability of hospitalization, given

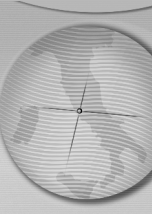
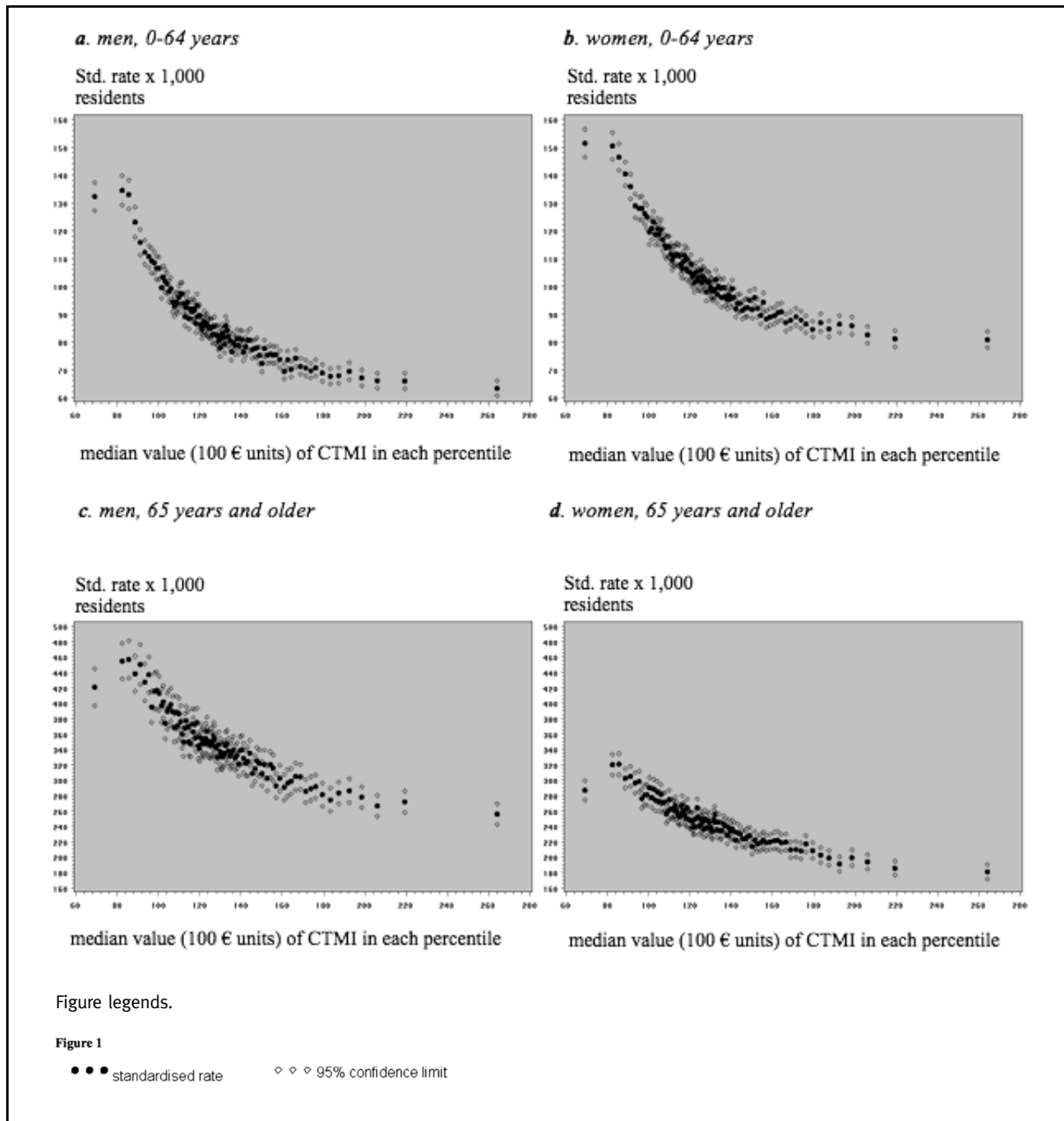


Figure 1. Hospital discharge standardized rates (x 1000 residents) across CTMI percentiles.



a health problem, can be heterogeneous by income level [14, 30]: if the persons with the highest income have a lower risk of hospitalization for each condition susceptible to inpatient treatment, the hospitalization gradient would lead to overestimate the true health gradient by income. There are reports of inappropriate hospitalization as a substitute for other forms of healthcare for less severe pathologies, among specific socially disadvantaged groups [31]. This results in, among these groups, the over-representation of admissions for less severe conditions within the general hospitalizations, with a consequent

distortion of the general hospitalization rates in the estimate of disease occurrence and in the estimate of the social gradient in morbidity. Finally, hospitalization can supply the lack of other forms of care (e.g., social care) when the offer of appropriate or effective services does not meet demands or is not equitable; these circumstances can be more concentrated in socially disadvantaged groups, generating high rates of hospitalization which do not correspond to the actual health needs of these groups. All of these processes can have dimensions and reciprocal relationships that can vary considerably by specific cause of hospitalization, by gender, and by

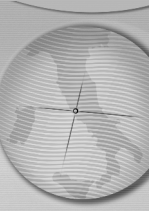
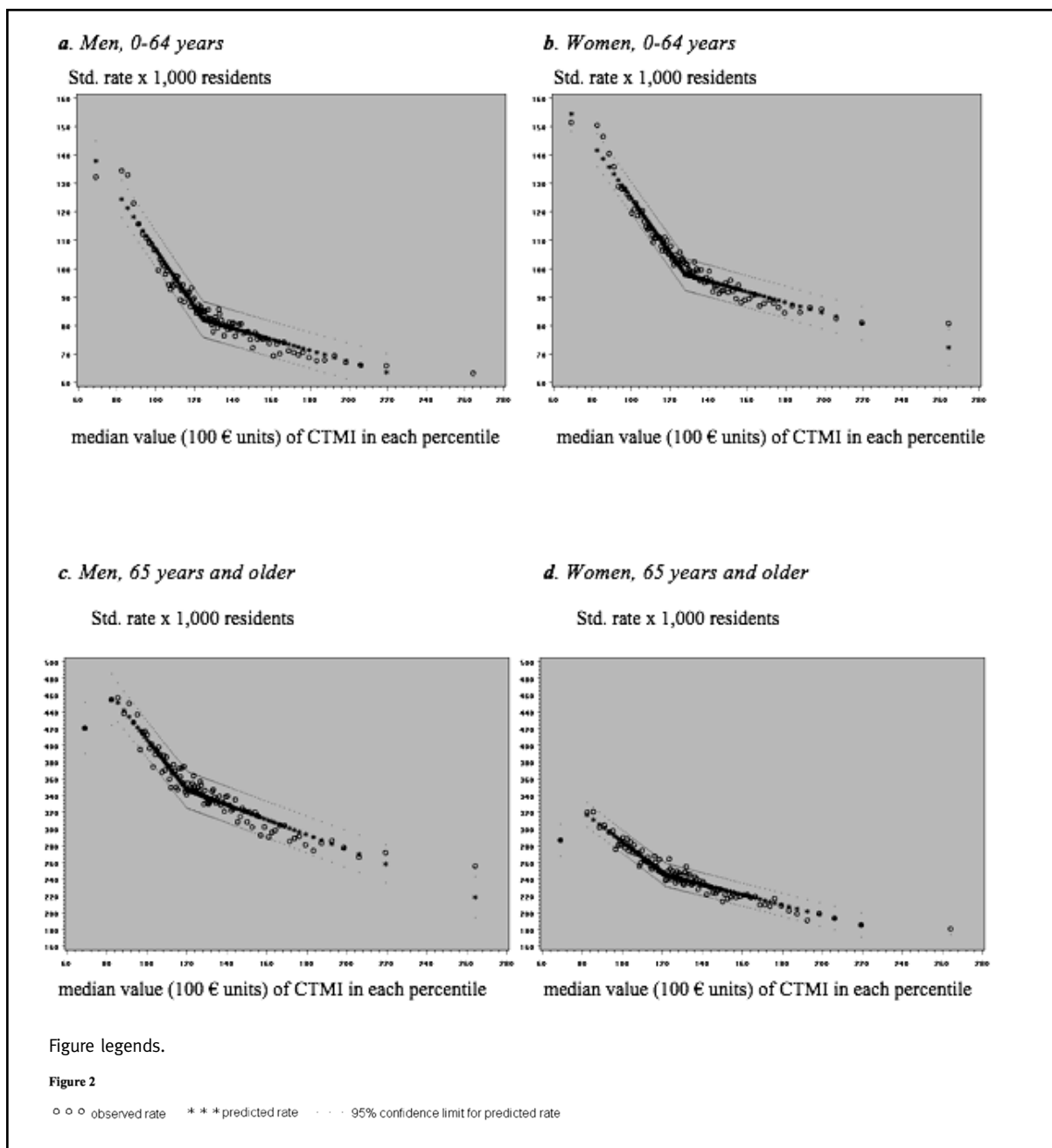


Figure 2. Observed and model-predicted hospital discharge standardized rates (x 1,000 residents), across CTMI percentiles.



age-group, yet they are produced by the specific health context being considered. On this concern, it is also worth mentioning the potential contribution of different models of hospital care among regions to whom Milan, Turin, Rome and Bologna belong. Actually the Italian National Health Service is organised into different systems at the regional level: they are mainly characterised by public offer in Emilia-Romagna and Piedmont (the regions surrounding, respectively, Bologna and Turin), while Lazio (surrounding Rome) and Lombardia (surrounding Milan) are characterised by a relevant fraction of private offer units, with a

real public/private competition (difference between provider and financier) model in the latter case. This could be a potential source of heterogeneity of income inequalities in health care models, so affecting hospitalisation, among the cities considered, which is the object of a future investigation. Our results and the available empirical evidence do not allow us to distinguish between the inequalities in hospitalization attributable to social differences in needs and those attributable to differences in the access to, and use of, healthcare services controlling for needs. Future analyses will be conducted to

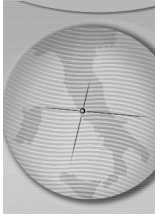


Table 2. Hospital discharge standardized rates (x 1,000 residents) across CTMI percentiles, as a function of median value (100 # units) of CTMI in each percentile.

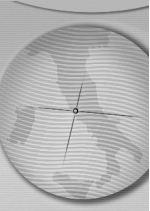
	Men			Women		
age 0-64 years,						
model (1)	estimate	95%CI		estimate	95%CI	
x1	124.48	122.05	126.91	128.14	125.89	130.39
α	207.40	199.10	215.70	220.50	213.90	227.10
β1	-1.00	-1.08	-0.93	-0.96	-1.02	-0.90
β2	-0.20	-0.23	-0.15	-0.19	-0.22	-0.16
age 65 years and older,						
model (2)	estimate	95%CI		estimate	95%CI	
x0	83.46	78.92	88.01	82.32	78.73	85.91
x1	120.04	116.53	123.54	121.89	118.14	125.64
α	245.20	72.26	418.20	129.00	115.40	142.60
β0	2.54	0.27	4.82	2.28	n.c.	n.c.
β1	-3.02	-3.42	-2.61	-1.82	-2.03	-1.61
β2	-0.89	-1.41	-0.37	-0.61	-0.68	-0.55

evaluate the gradient for specific causes of hospitalization or procedures that allow for the identification of the weight of these components. Under another angle, our results on income gradient in hospital utilization highlight potentials for demand-side savings in health care expenditures, which have to be focused on determinants of health needs and services utilization of the lower income population.

In addition to the above considerations, the design adopted for this study has several limitations. Specifically, we attributed a small-area indicator of income to residents and to hospital discharges on the basis of the individual's place of residence. Attributing an aggregated indicator to the individual can lead to measurement errors in defining individual social position, which increase with the size of the area; this in turn can dilute the estimate of the association between social position and health at the individual level [32].

Attributing an area economic indicator to individual data can be an additional source of distortion related to construct validity: in fact, the effects produced on health can be influenced by both individual economic circumstances and, to a lesser extent, the socio-economic characteristics of the area [15,33,34]. Although we were not able to distinguish between these two factors in terms of their effects, the impact of the contextual socio-economic characteristics is presumed to be negligible when considering small areas (such as census tracts), given that these areas lack administrative, historical, and social connotations capable of influencing the geographic distribution of contextual determinants of health and healthcare.

The grouping of census tracts based on quantiles of pooled tract median incomes in the four cities produced an additional aggregation of individuals. This aggregation, not excluding



heterogeneity among cities in terms of mean and distribution of income, could have characterized certain quantiles for their higher homogeneity of individuals according to the city of residence. Moreover, given the definition of quantiles based on pooled distribution of median area incomes, their effect probably expresses the hospitalization impact by the absolute degree of economic resources available, rather than that attributable to the relative (city-specific) economic position of the individuals.

An important limitation of many studies focused on income inequalities in health is that they are not always able to sufficiently take into account the possible reverse causation (i.e., the loss of economic resources resulting from health related downward social mobility). It has also been observed that in the lowest ranks of income distribution, fluctuations in income are greater because of greater job instability; it is probable that the presence of a health problem could cause job loss and contribute to these fluctuations [10]. Attributing an area economic indicator to a person, as we did, could in part mitigate the effect of person's decrease in income conditioned by health, unless in the most disadvantaged areas there is a concentration of individuals whose health is already compromised. Moreover, a portion of general hospitalizations are for health problems that began not long before hospitalization; as for the hospital discharges occurred after income reference year, which is 1998, it is also difficult to hypothesise an influence of the health problem on income level measured. Moreover, the analysis relative only to hospitalizations after 1998 provided similar results. A previous study conducted on data from Turin residents also showed that hospitalization has a rather low impact on downward social mobility [35].

Identifying the underlying mechanisms of the income-hospitalization relationship poses additional difficulties, including that of disentangling the actual role of economic resources, as independent on other important social determinants of health, such as occupation and education. Although we did not control for these factors, other studies have shown that the association between economic resources (wealth and family income) and mortality, specific for gender and age, persists even when controlling for them [4]. Moreover, in our case, family income, which was used to calculate the CTMI, measures the economic resources provided by work, pension, real estate and participation in societies, which are truly shared by the family and which

contribute to defining the state of social and material well being of all family members, including those who are not "breadwinners" [36].

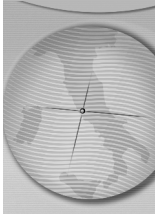
Regarding the shape of the relationship between income and hospitalization, the results show that it is curvilinear, with a less marked decrease in the hospitalization rate above a certain income. Although the modelling was based on a double process of aggregation of the individuals and their incomes (and thus subject to the potential biases mentioned above), the results seem to confirm the hypothesis of a decreasing health improvement, expressed in terms of hospitalization, as individual income increases, and observed for both males and females and both young and old.

That revenue from savings, which constitutes a significant part of income for the middle-high classes, was not considered in the estimation of income probably resulted in an overestimate of the slopes in the last segments of the estimated models, underestimating the overall concavity of the income-hospitalization relationship. Furthermore, the possible effect of tax evasion and elusion, which could presumably affects the income estimates for the middle-high classes, could act in the same direction.

The various attempts to empirically verify the diminishing return have suggested comparing countries with a high degree of income inequalities (such as the United States, where the curvilinear shape of the income-health relationship has been empirically confirmed) to countries with greater equity in income distribution, such as Finland, where the diminishing return was contradicted, probably because of welfare ability to compensate for the health disadvantages of poverty [21]. The Italian cities considered in this study could possibly be classified among the first group of countries in terms of how income affects health, with the distinction given by the protection shown by elderly in absolute poverty. Nonetheless, the strength, direction, and shape of the relationship between hospitalization and income could not be inferred without reference to the specific population, health system, time, macro and micro-social context under investigation, constraining our induction ability with respect to the complex etiologic link that underlies the inequalities in health by income and their relation to the use of health services.

Acknowledgement

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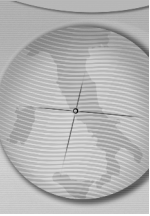
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