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Where wealth matters more for health: The wealth–health gradient in 16 countries

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ABSTRACT

Researchers have long demonstrated that persons of high economic status are likely to be healthier than persons of low socioeconomic standing. Cross-national studies have also demonstrated that health of the population tends to increase with country's level of economic development and to decline with level of economic inequality. The present research utilizes data for 16 national samples (of populations fifty years of age and over) to examine whether the relationship between wealth and health at the individual-level is systematically associated with country's level of economic development and country's level of income inequality. The analysis reveals that in all countries rich persons tend to be healthier than poor persons. Furthermore, in all countries the positive association between wealth and health holds even after controlling for socio-demographic attributes and household income. Hierarchical regression analysis leads to two major conclusions: first, country's economic resources increase average health of the population but do not weaken the tie between wealth and health; second, a more equal distribution of economic resources (greater egalitarianism) does not raise health levels of the population but weakens the tie between wealth and health. The latter findings can be mostly attributed to the uniqueness of the US case. The findings and their significance are discussed in light of previous research and theory.

Introduction

Social scientists agree that quality of life, in general, and health conditions, in particular, are positively associated with economic resources. That is, wealthier people and persons of higher socioeconomic standing not only enjoy higher standard of living than poor people but they also tend to live longer and to be healthier (Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997; Kennedy, Kawachi, & Prothrow-Stith, 1996; Wilkinson & Pickett, 2008). Two alternative explanations have been advanced in the literature for understanding the nature of the causal relations between economic resources and health. The first view suggests that economic resources afford healthier living conditions and the purchase of better medical care. According to this view, rich people have better access than poor people to advanced medical resources, quality treatment, expensive medications, healthy nutrition and preventive medicine (Deaton, 2007; Van Doorslaer, Masseria, & Koolman, 2006). The alternative view contends that poor health may lead to deterioration and depletion of economic resources, and in extreme cases, illness may even lead to impoverishment due to high cost of medical treatment (Adams, Hurd, McFadden, Merrill, & Riberio, 2003; Smith, 2005). Indeed the two views are neither contradictory nor mutually exclusive and both provide convincing explanations for the positive association between economic standing and health.

Although the literature on the relationship between economic resources and health has become substantial, to the best of our knowledge, no one yet has provided a direct and systematic examination of the extent to which the effect of wealth on health differs across social systems. While previous cross-national studies reveal that the average health of the population tends to rise with level of economic development (Hurd & Kapteyn, 2003; Pickett & Wilkinson, 2007; Van Doorslaer et al., 2006) and to decline with level of income inequality (Blakely, Kennedy, Glass, & Kawachi, 2000; Kennedy et al., 1996; Van Doorslaer et al., 1997; Wildman, 2001, 2003), they did not examine whether all segments of the population equally benefit from availability and distribution of economic resources. In other words, we do not yet know whether the association between wealth and health (i.e. the wealth-health gradient) tends to be weaker in countries with more abundant economic resources and whether the relationship varies in accordance with countries' level of income inequality.

This paper contributes to the literature on the "health gradient" by providing an examination of the strength of the association

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between personal wealth and health across countries. To this end we assembled data on 16 national samples of older populations and estimated a series of country-specific regression equations as well as hierarchical linear regression models predicting health of individuals as a function of their wealth, income and socio-demographic attributes. Such an analysis permits us to examine, within a cross-national comparative framework, whether the association between personal economic resources and health tends to decline with country's wealth and to increase with income inequality.

In what follows we first review previous studies; second, discuss the data sources and measurements of the variables utilized in the analysis; third, estimate a series of regression equations to examine the association between wealth and health within specific countries; and fourth, estimate bi-level hierarchical linear regression models to examine whether and to what extent the association between individuals' wealth and health (i.e. the wealth–health gradient) is likely to decrease with country's level of economic development and to increase with country's level of income inequality. Finally, we discuss the findings in light of theory and previous research on the health gradient.

Past research

The thesis that economic resources are positively associated with health (often referred to in the literature as the "health gradient") has received considerable support through three major bodies of research. The majority of studies on the "health gradient" have focused on the association between socio-economic standing of individuals and indicators of health and mortality within single countries. These studies have generally found in a variety of countries (the US, Finland, Belgium, the United Kingdom, Canada, the Russian Federation, and Sweden) that individuals of higher socio-economic standing tend to live longer and to be healthier (Berkman & Gurland, 1998; Deaton, 2007; Huisman, Kunst, & Mackenbach, 2003; Laaksonen, Tarkiainen, & Martikainen, 2009; Raphael, 2000; Spengler et al., 2004; Sundquist & Johansson, 1997; Warden, 1998). These studies demonstrate that the positive association between economic standing and health continues into old age and that the association holds even after controlling for a variety of demographic and social attributes of individuals (Berkman & Gurland, 1998; Huisman et al., 2003).

The second body of research is substantially smaller. It is comprised of comparative studies that examine the relationship between economic status of individuals and their health across countries. Although countries vary considerably in level of health, in most societies people with more economic resources tend to be healthier than people with less resources (Mirowsky, Ross, & Reynolds, 2000; Schnittker & McLeod, 2005). For example, using data for nine industrialized countries Van Doorslaer et al. (1997) found that income is positively associated with self-assessed health. Likewise, Hurd and Kapteyn (2003) show that both in the US and Holland wealth or income is strongly and positively associated with health. Huisman et al. (2003) who focused on health problems of the elderly population in 12 European countries found that health problems were more frequent among people of low socioeconomic status than among persons of high socioeconomic status. Eikemo, Bambra, Joyce, and Dahl (2008), who analyzed data from 23 European countries (populations age 25 and over) show that in all countries regardless of the welfare state regime self-reported health tends to increase with income. Similar conclusions were reached by Avendano, Glymour, Banks, and Mackenbach (2009) with regard to populations over the age 50 in the US, Europe, and the UK.

The third group of studies is composed of macro-level (cross-national or cross-regional) ecological analysis of the relationship between structural characteristics of spatial units (i.e. nations, regions, counties) and indicators of population health and mortality (Kawachi et al., 1997; Kennedy et al., 1996; Pickett & Wilkinson, 2007). This body of research reveals that population's health tends to be higher and mortality rates tend to be lower in places characterized by higher levels of economic resources (i.e. mean or median income, GDP per capita) and by a more egalitarian distribution of income (e.g. Gini index). For example, Babones (2008) demonstrates that life expectancy tends to rise with country's economic standing and to decline with level of income inequality. Likewise, Wilkinson (1996, 2006) shows that health and longevity of the population are higher in more egalitarian societies and where economic resources are more abundant. In general, the comparative studies provide support for the argument that the population at large benefits from higher level of economic resources and from a more equal distribution of these resources (see also Eikemo et al., 2008; Kawachi et al., 1997; Kennedy et al., 1996; Pickett & Wilkinson, 2007).

It is worth noting that the several researchers criticized the health inequality hypothesis (e.g. Judge, 1995; Mellor & Milyo, 2001). In addition, Beckfield (2004) found statistically significant but small negative effects of income inequality on population health but no evidence that changes in income inequality are associated with changes in health. Likewise, several researchers suggest that inequality itself may not affect population health and that the strong association between the two may reflect an effect of welfare policy or of other factors on health (House, 2001; Mellor & Milyo, 2001; Muntaner & Lynch, 1999).

A number of comparative studies have utilized a multilevel approach to examine the impact of structural characteristics of spatial units (i.e. countries, regions, counties) on health of individuals (see Subramanian & Kawachi, 2004 for a comprehensive review of this literature). For example, Kennedy, Kawachi, Glass, and Prothrow-Stith (1998), who studied health of the population in the 50 states of the US, found that higher Gini coefficients were associated with lower levels of overall health. Using multilevel analysis on 3139 US counties Wilkinson and Pickett (2008) concluded that narrower income differences benefit people in both wealthy and poor areas and may, paradoxically, do little to reduce health disparities. In general, studies that utilized data for American States, Metropolitan Areas and Counties (Blakely et al., 2000; Subramanian, Delgado, Jadue, Vega, & Kawachi, 2003; Subramanian & Kawachi, 2004; Subramanian, Kawachi, & Kennedy, 2001) provide support for the thesis that inequality has detrimental consequences for health (e.g. hypertension, smoking, body mass index and self-rated health). Likewise, a study on the Chilean population by Subramanian et al. (2003) reveals that the odds of poor health are negatively related to the level of community income but increase with growing levels of income inequality. By contrast, Blakely, Atkinson, and O'Dea (2003) did not find any significant effect of income inequality in regions of New Zealand on odds for mortality.

Researchers who have studied the health gradient tend to agree that the positive association between country's GDP or population's median income and health of the population represents enhanced ability of rich communities to allocate economic resources to improve health conditions and to prevent epidemic disease and unhealthy behavior. The negative association between income inequality and population's health is viewed as an indication that in non-egalitarian social systems large segments of the population (most likely the poor) do not have equal access to medical services and medical resources, hence, the poor cannot equally benefit from medical services much as the rich do. According to this view

income inequality produces disintegration, which results, in turn, in "unhealthy societies" (Wilkinson, 1996, 2006, see also Beckfield, 2004; Beckfield & Krieger, 2009; Kunitz, 2007). Likewise, high inequality societies are characterized not only by under investment in social services but also by welfare and health care policies that provide differential access to high quality health care services to the rich and the poor.

Curiously, whereas researchers tend to agree that characteristics of societies (especially economic resources and income distribution) are likely to affect health of the population, they have not yet studied the extent to which the association between wealth and health (i.e. the wealth–health gradient) varies systematically with countries' economic resources and with unequal distribution of these economic resources. Based on previous studies on the topic we expect that the strength of the association between individual's wealth and health would decrease with countries' economic resources and would increase with the level of income inequality.

Data sources and variables

The present analysis incorporates three separate data sets to arrive at sixteen nationally representative full probability samples of respondents in households where at least one member of the household was 50 years or over. We believe that the focus on respondents over the age 50 provides an advantage because persons in advanced stages of their life-cycle have had opportunity to accumulate wealth, and that their well-being and health condition are more dependent on economic resources. Data for 14 European countries and for Israel were obtained from either the 2004–2005 (first wave) or 2006–2007 (second wave) of the Survey for Health, Ageing and Retirement in Europe (SHARE). Data for the United States were obtained from the 2004 (seventh) wave of the Health and Retirement Study (HRS) and data for United Kingdom were obtained from first wave (2002/03) of the English Longitudinal Study of Ageing (ELSA). The list of countries, data source, year of the survey, and number of respondents are displayed in Appendix A.

Data for SHARE and ELSA were gathered by means of face-to-face interviews conducted in respondents' homes using CAPI. The HRS interviews were conducted mainly by phone. The questionnaires cover a wide range of topics and are highly structured to ensure comparability of data and of data collection. Household information was obtained from the primary respondent. In addition to the face-to-face interview respondents filled out a short self-completion questionnaire providing detailed additional information on assets. For the purpose of the present analysis the most relevant information is family financial and real assets and liabilities, used to estimate net worth, and a detailed list of illnesses and physical limitations.

The dependent variable – Physical Health Index – is constructed as a sum of health impairments from a list that pertains to limitations with activities of daily living, limitations in mobility, problems with arm and fine motor function, chronic diseases and illness symptoms. The list includes 41 items used to construct the Physical Health Index. The index was calculated as 1 minus the proportion of items selected by the respondent, multiplied by 100. Its values, therefore, range from 0 to 100; the better the respondent's health the higher is the value of the index.[1]

Net worth of respondent's household as an indicator of wealth serves as the main independent variable. Household net worth is defined as the sum of net real and net financial assets minus debts. Financial assets reflect the sum of values of accounts, bonds, stocks, mutual funds and savings. Real assets pertain to the value of primary residence net of mortgage, other real estate, owned businesses and owned cars. All assets are measured in Euro values. Because the distribution of net worth is highly skewed and contains both negative and zero values (Cobb-Clark & Hildebrand, 2006; Semyonov & Lewin-Epstein, 2011) we transformed the distribution of net worth to a rank order scale to allow cross-national comparison. Unlike income which represents flows of economic resources, net worth represents the stock of economic resources that are at the disposal of an individual; this stock is especially significant in older age when the flow of income does not fully and accurately captures economic standing of individuals. Nevertheless, we included income as another indicator of one's individual resources (transformed to a rank order) mostly for control purposes and for comparison with previous studies that focused on income–health gradient.

In addition, we introduced a series of socio-demographic indicators as control variables. They include: age of respondent (in years), gender (man = 1), immigrant status (immigrant = 1) respondent's education (2 dummy variables: academic and less than high-school, while high-school education serves as omitted category) and whether respondent lives with partner (living with partner = 1). The list of variables, their definition, and mean values are listed in Appendix B.

Analysis and findings

Descriptive overview

Table 1 provides a descriptive overview of the average value of the index of physical health and the correlation between wealth and health, income and health, and wealth and income respectively by country. The data reveal considerable variation across countries in the values of physical health. On average United States, Poland, Spain and Israel have the poorest level of health while Switzerland, Netherlands, United Kingdom and Sweden report the highest level of health. The data further show that in all countries wealth and income are positively and significantly associated and that both are positively associated with health (except for income and health in Austria). The association between wealth and health is highest in

Table 1
Mean Physical Heath Index (std. deviation), Pearson correlation estimates between physical index and wealth, between physical health index and income, and between income and wealth in 16 countries.

	Mean physical health (std. deviation)	Correlation between wealth and physical health	Correlation between income and physical health	Correlation between income and wealth
Austria	89.76 (10.53)	0.120**	0.037	0.340**
Germany	89.46 (10.77)	0.221**	0.189**	0.399**
Sweden	89.77 (10.74)	0.236**	0.323**	0.360**
Netherlands	91.38 (10.12)	0.250**	0.181**	0.373**
Spain	85.19 (14.37)	0.121**	0.168**	0.270**
Italy	87.81 (12.66)	0.198**	0.138**	0.377**
France	88.64 (11.26)	0.214**	0.228**	0.420**
Denmark	89.58 (11.02)	0.241**	0.301**	0.451**
Greece	89.01 (11.67)	0.237**	0.261**	0.421**
Switzerland	92.86 (8.42)	0.192**	0.176**	0.389**
Belgium	88.79 (11.31)	0.247**	0.205**	0.358**
Israel	86.17 (14.51)	0.200**	0.199**	0.588**
Czech Republic	87.74 (11.89)	0.230**	0.260**	0.330**
Poland	82.08 (15.39)	0.152**	0.168**	0.259**
United Kingdom	90.69 (9.97)	0.276**	0.218**	0.468**
United States	79.12 (14.86)	0.290**	0.366**	0.555**

Note: $^{**}p < 0.01$ (two tailed test).

[1] The data obtained from the SHARE, ELSA and HRS projects were utilized for secondary analysis and our study was exempt from ethic review. ELSA and HRS studies include 31 and 30 items, respectively. The physical health indices for these samples were adjusted based on the sets of items that were common to these data sets and the SHARE data.

the US and in the United Kingdom (the Pearson Correlation is $r = 0.290$ and $r = 0.276$ for the US and for UK, respectively) and lowest in Spain and Austria (the Pearson correlation is $r = 0.121$ and $r = 0.120$ for Spain and Austria, respectively).

Country-specific multivariate analysis

Rich people may differ from poor people not only in terms of health but also in their social and demographic attributes. Therefore, in the analysis that follows we conduct multivariate regression analysis to examine whether the association between wealth and health (and income and health) holds when taking into consideration variations in income and socio-demographic characteristics of respondents. The results of this analysis are presented in Table 2 in the form of coefficients obtained from 16 country-specific regression equations. In each equation health is predicted as a function of wealth controlling for socio-demographic attributes of individuals (i.e. age, gender, education, immigrant status, living with a partner) and income.

Other things being equal, in all countries, health is likely to deteriorate with age (the effect of age is negative and significant in all equations) and to improve with education (the effect of education is positive and significant in all equations). In most countries men report better health than women (only in Denmark and the UK the positive effect of gender is not statistically significant) and in half of the countries immigrants' health is not as good as the health of native-born (i.e. in Germany, Sweden, Netherlands, Denmark, Switzerland and Israel). Living with a partner, however, does not have a systematic and consistent impact on health.

In many, but not all, countries income is positively associated with health (net of wealth and socio-demographic attributes).Yet, the data clearly reveal that even after controlling for socio-demographic attributes and for income, wealth exerts a significant and positive effect on health in all countries (with only one exception – the coefficient in Austria is not statistically significant). That is, other things being equal, in all countries, wealthy people are likely to be healthier than poor people even after taking into consideration variations in socio-demographic attributes and in income.

Estimating Hierarchical Linear Models

The findings presented thus far underscore the relevance of wealth for understanding health disparities. Indeed, among those age 50 and older, health is more strongly correlated with wealth than with current income. Yet, these findings do not provide us with answers to two questions: first, whether health of the population tends to increase with a country's level of economic resources and to decrease with level of income inequality (net of personal wealth and net of the socio-demographic characteristics of the individuals residing in the country); second, to what extent is the within-country positive association between wealth and health systematically associated with country's economic development and economic inequality. In order to address these issues we pooled the data for all 16 countries into one data set and estimated a series of Hierarchical Linear Models (HLM) in which individuals (first-level variables) are nested within countries (second-level variables).

The HLM analysis permits us to partition the variation in the health index into two components: the portion of the variation in physical health attributed individual-level variables and the portion of the variation attributed to country-level variables. It also enables us to estimate the net impact of individual-level variables (e.g. wealth, income, education, age) on health and the net impact of country-level variables on health. In addition, HLM analysis permits us to examine the extent to which the wealth–health

Table 2
OLS regression coefficients (std. errors) predicting physical health index, by country.

	Wealth (%)	Income (%)	Age (centered)	Male	Low education	High education	Immigrant	Living with partner	Constant	Adjusted R^2	Number of observations
Austria	0.015 (0.009)	−0.032** (0.009)	−0.296** (0.025)	2.078** (0.492)	−3.578** (0.542)	−0.441 (0.611)	1.768* (0.783)	1.359* (0.550)	90.011** (0.648)	0.15	1843
Germany	0.056** (0.007)	−0.011 (0.007)	−0.402** (0.021)	1.569** (0.376)	−2.105** (0.513)	0.951* (0.436)	−1.276** (0.462)	0.460 (0.449)	86.465** (0.537)	0.20	2939
Sweden	0.058** (0.007)	0.028** (0.008)	−0.364** (0.019)	2.813** (0.351)	−0.605 (0.430)	0.819 (0.512)	−1.574* (0.630)	0.145 (0.503)	84.284** (0.567)	0.23	2994
Netherlands	0.055** (0.007)	−0.000 (0.007)	−0.226** (0.019)	2.910** (0.360)	−0.668 (0.443)	0.697 (0.545)	−0.410 (0.744)	2.035** (0.482)	85.866** (0.651)	0.15	2861
Spain	0.030** (0.010)	0.007 (0.010)	−0.514** (0.027)	5.666** (0.549)	−2.212* (1.039)	0.766 (1.384)	1.141 (1.827)	−0.400 (0.649)	83.020** (1.277)	0.21	2340
Italy	0.056** (0.009)	0.003 (0.009)	−0.482** (0.027)	5.093** (0.468)	−1.128 (0.651)	0.854 (1.145)	0.977 (1.887)	−0.807 (0.593)	83.982** (0.915)	0.19	2499
France	0.056** (0.007)	0.009 (0.008)	−0.387** (0.019)	2.384** (0.379)	−0.864 (0.455)	1.249* (0.564)	−0.357 (0.519)	0.031 (0.440)	84.572** (0.600)	0.22	2980
Denmark	0.059** (0.010)	0.008 (0.013)	−0.293** (0.029)	1.785** (0.515)	−2.282** (0.659)	0.605 (0.603)	−4.135** (1.330)	0.009 (0.608)	85.888** (0.744)	0.18	1611
Greece	0.029** (0.008)	−0.011 (0.008)	−0.469** (0.021)	3.909** (0.408)	−1.419** (0.507)	0.059 (0.647)	−2.447* (1.238)	1.387** (0.470)	86.306** (0.686)	0.29	2677
Switzerland	0.045** (0.010)	−0.007 (0.011)	−0.263** (0.026)	1.677** (0.520)	−0.885 (0.543)	−0.012 (0.972)	−1.977** (0.694)	−0.155 (0.610)	91.043** (0.766)	0.16	957
Belgium	0.058** (0.007)	−0.008 (0.007)	−0.329** (0.018)	3.355** (0.343)	−1.264** (0.417)	0.647 (0.488)	−1.275 (0.662)	1.711** (0.414)	84.037** (0.573)	0.19	3692
Israel	0.048** (0.011)	0.025* (0.011)	−0.544** (0.028)	2.112** (0.511)	−5.332** (0.581)	0.836 (0.650)	−2.691** (0.532)	2.844** (0.648)	82.586** (0.857)	0.28	2489
Czech Republic	0.037** (0.008)	0.028** (0.009)	−0.434** (0.023)	2.587** (0.423)	−2.002** (0.448)	0.849 (0.760)	−0.864 (0.971)	0.007 (0.495)	84.429** (0.630)	0.21	2742
Poland	0.022* (0.010)	0.043** (0.011)	−0.598** (0.032)	4.446** (0.575)	−1.502* (0.663)	1.113 (1.107)	−4.057* (1.720)	−1.849* (0.718)	78.926** (0.895)	0.22	2416
United Kingdom	0.077** (0.004)	0.005 (0.004)	−0.194** (0.009)	0.853** (0.181)	−0.874** (0.221)	0.120 (0.257)	0.329 (0.323)	−0.112 (0.212)	86.634** (0.293)	0.13	11,386
United States	0.094** (0.004)	0.068** (0.005)	−0.358** (0.010)	3.031** (0.199)	−2.581** (0.238)	1.190** (0.261)	3.531** (0.317)	−0.374 (0.237)	70.003** (0.264)	0.22	19,294

Note: $^{**}p < 0.01$, $^{*}p < 0.05$ (two-tailed test); omitted categories: female = 0; intermediate education = 0; not immigrant = 0; is not living with partner = 0.

Table 3
Effects of individual-level variables on physical health index across countries, coefficients (std.errors) obtained from HLM analysis.

	Models					
	(1)	(1a)	(2)	(2a)	(3)	(3a)
Individual level effects						
Intercept	86.784** (0.823)	87.955** (0.662)	86.911** (0.832)	87.773** (0.661)	87.027** (0.826)	87.923** (0.662)
Wealth (%)	0.054** (0.007)	0.052** (0.004)	–	–	0.054** (0.005)	0.050** (0.004)
Income (%)	–	–	0.026** (0.009)	0.020* (0.007)	0.009 (0.007)	0.005 (0.007)
Age	−0.370** (0.005)	−0.351** (0.005)	−0.334** (0.005)	−0.348** (0.005)	−0.358** (0.005)	−0.354** (0.005)
Male	2.680** (0.092)	2.502** (0.1)	2.512** (0.092)	2.431** (0.101)	2.631** (0.091)	2.510** (0.100)
Low education	−1.800** (0.109)	−1.627** (0.121)	−2.267** (0.109)	−2.012** (0.122)	−1.692** (0.109)	−1.586** (0.121)
High education	0.880** (0.129)	0.421** (0.147)	1.119** (0.131)	0.801** (0.148)	0.681** (0.130)	0.460** (0.148)
Immigrant	0.135 (0.156)	−1.224** (0.176)	−0.041 (0.157)	−1.559** (0.176)	0.246 (0.155)	−1.250** (0.175)
Living with partner	0.649** (0.106)	0.531** (0.116)	0.911** (0.11)	1.072** (0.121)	0.302** (0.110)	0.535** (0.121)
N (individual)	65,955	46,600	65,955	46,600	65,955	46,600
N (country)	16	15	16	15	16	15

Note: $^{**}p < 0.01$, $^{*}p < 0.05$ (two tailed test).
In Equations (1), (1a) wealth slope is random; in Equations (2), (2a) income slope is random; in Equations (3), (3a) – both wealth and income slopes are random. Equations (1a), (2a), and (3a) are estimated without the US. Omitted categories: female = 0; intermediate education = 0; not immigrant = 0; is not living with partner = 0.

gradient tends to increase with economic resources of the country and to decline with level of economic inequality.

We start the HLM analysis by estimating three regression equations. In Equation (1) we let health be a function of wealth plus all individual level variables (previously included in Table 2). As we are interested in the effect of country-level attributes on the relationship between wealth and health (the gradient) we allow the wealth slope to vary across countries. We set the effect of other variables to be equal across countries. In Equation (2) we replace wealth with income allowing the income slope to vary across countries. In Equation (3) we include both wealth and income as predictors of health letting the slopes of both variables to vary across countries. Because the US has long been viewed as an exceptional case with regard to its health-care system and the pathways and mechanisms by which economic resources affect health outcomes (Kawachi & Kennedy, 2003; Subramanian & Kawachi, 2004) each equation is estimated twice: once with the US and once without the US. The results of the analysis are presented in Table 3.[2]

The calculation of the intra-class correlation coefficient shows that the between-country variance in health accounts for approximately 7% and 5% of the total variance in the health index across the 16 and 15 countries, respectively. Clearly, the United States accounts for a disproportionate part of the total between country variance in the health index. The findings presented in Table 3 are largely consistent with those observed in Table 2. In all equations health tends to decrease with age and to increase with education; health tends to be higher among men and among those living with a partner. Immigrant status, however, has a significant negative effect on health only in the models where the US is excluded from the data. Net of all socio-demographic variables, health is positively associated with wealth in Equation (1) and with income in Equation (2). However, when both wealth and income are included among the predictors of health (in Equation (3)), only wealth retains its positive and significant effect on health. That is, across the countries, whether 16 or 15, physical health tends to increase with wealth net of income but not with income (net of wealth).Indeed, the findings lend firm support to the "wealth–health gradient" thesis but only limited support to the "income–health gradient" thesis. Subsequently, in the analysis that follows we fix the effect of income along with the socio-demographic variables and allow only the wealth slope in relation to the health index to vary across countries.

The next phase of the analysis introduces country-level variables into the models. The variables included in the analysis are those traditionally used in comparative studies as indicators of community economic resources and level of economic egalitarianism. In the present research, country's economic resources are captured by the two alternative indicators: GDP per capita and population's median income (MEDINC). Country's level of economic inequality (or level of egalitarianism) is depicted by the following two indicators: share of income (in percent) held by top 20 percent of the population (TOP20) and ratio of the share of income held by top 20 percent of the population to the share of income held by the bottom 20 percent of the population (RATIO). Because the number of countries included in the analysis is small and the degrees of freedom at the second level are limited, the HLM regression equations are estimated with all individual-level characteristics (first level variables) and only one country-level characteristic (a second-level variable) at a time.

Table 4 presents the results from the two-level regression equations. In Equations (1) and (3) we let physical health be a function of wealth and all individual-level variables plus country's GDP and population median income, respectively. In Equations (2) and (4) we add an interaction term between household wealth and each of the country-level variables, respectively, to examine the hypothesis that the "wealth–health gradient" tends to decline with the increase in countries' economic resources. Each equation is estimated twice: once with all 16 countries included (1, 2, 3 and 4), and a second time without the US (1a, 2a, 3a, 4a).

The coefficient estimates presented in Table 4 show that the effects of both indicators of country's economic resources on the average level of health in a country (in Equations (1), (1a), (3), and (3a)) are positive and significant at conventional level of statistical tests. In other words, the positive and significant effect of either GDP or MEDINC in Equations (1) and (3) implies that health of the population tends to improve, on average, with country's economic resources. The effect of country's economic resources on health appears to be somewhat stronger when the US is excluded from the analysis (Equations (1a) and (3a)). Evidently, including the US in the data suppresses the impact of economic resources on health due to its relatively high level of economic resources and its relatively poor health.

[2] It should be noted that in HLM the regression estimates are computed as composite scores over all groups (countries). Groups with more precise estimates are given greater weight in the calculation. As precision is typically related to sample size the algorithm takes country differences in sample size into account (see Hofmann, 1997; Raudenbush & Bryk, 2002). We should also note that we performed sensitivity analysis in which we excluded each one of the sixteen countries at a time. This analysis did not change the results and revealed that the coefficients were not affected by the relative size of any of the national samples. The US is the only country that its exclusion from the analysis has altered some of the findings.

Table 4
Effects of individual-level and country-level indicators of economic development on physical health index, coefficients (std. errors) obtained from HLM analysis.

	Models							
	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)
Individual level effects								
Intercept	86.956** (0.834)	87.969** (0.404)	86.958** (0.823)	87.969** (0.405)	86.955** (0.797)	87.968** (0.381)	86.956** (0.802)	87.9671** (0.381)
Wealth (%)	0.050** (0.006)	0.051** (0.004)	0.050** (0.006)	0.051** (0.005)	0.050** (0.006)	0.051** (0.005)	0.050** (0.006)	0.051** (0.005)
Income (%)	0.016** (0.002)	0.001 (0.002)	0.016** (0.002)	0.001 (0.002)	0.016** (0.002)	0.0013 (0.002)	0.016** (0.002)	0.0012 (0.002)
Age	−0.361** (0.005)	−0.350** (0.005)	−0.361** (0.005)	−0.350** (0.005)	−0.361** (0.005)	−0.350** (0.005)	−0.361** (0.005)	−0.350** (0.005)
Male	2.65** (0.092)	2.501** (0.100)	2.650** (0.092)	2.501** (0.100)	2.650** (0.092)	2.501** (0.100)	2.650** (0.092)	2.501** (0.1)
Low education	−1.680** (0.109)	−1.616** (0.121)	−1.680** (0.109)	−1.616** (0.121)	−1.681** (0.11)	−1.620** (0.121)	−1.681** (0.110)	−1.620** (0.121)
High education	0.724** (0.130)	0.406** (0.148)	0.722** (0.130)	0.406** (0.148)	0.723** (0.130)	0.403** (0.148)	0.722** (0.130)	0.404** (0.148)
Immigrant	0.176 (0.156)	−1.225** (0.175)	0.177 (0.156)	−1.225** (0.175)	0.177 (0.156)	−1.222** (0.175)	0.1775 (0.156)	−1.222** (0.175)
Living with partner	0.383** (0.110)	0.510** (0.121)	0.381** (0.110)	0.510** (0.121)	0.383** (0.110)	0.510** (0.121)	0.382** (0.110)	0.510** (0.121)
Country level effect								
On the intercept								
GDP (Ln)	5.638** (1.666)	7.117** (1.304)	2.847 (2.717)	7.082** (1.374)	–	–	–	–
MEDINC (LN)	–	–	–	–	5.191** (1.603)	6.762** (1.184)	3.527 (2.546)	6.824** (1.204)
On wealth								
GDP (Ln)	–	–	0.027 (0.020)	0.001 (0.016)	–	–	0.017 (0.020)	−0.004 (0.015)
MEDINC (LN)	–	–	–	–	–	–	–	–
N (individual)	65,955	46,600	65,955	46,600	65,955	46,600	65,955	46,600
N (country)	16	15	16	15	16	15	16	15

Note: Standard errors are in parentheses; $^{**}p < 0.01$, $^{*}p < 0.05$, $_{\cdot}p < 0.10$.
Wealth and age are centered around their grand mean; The second-level predictors are centered around their grand mean. Omitted categories: female = 0; intermediate education = 0; not immigrant = 0; is not living with partner = 0. Wealth slope is allowed to vary across countries. Equations (1a), (2a), (3a), and (4a) are estimated without the US.

The findings, however, do not support the hypothesis that the association between wealth and health at the individual-level tends to weaken with greater availability of economic resources. The effect of household wealth on health does not vary across different levels of country's economic resources as evident by the insignificant interaction effects between wealth and GDP or wealth and MEDINC (in Equations (2), (2a) and (4), (4a), respectively). We can conclude on basis of these results that health of the population tends to increase with level of country's economic resources, but health disparities between rich and poor people do not appear to be lower in countries with greater economic resources.

The equations presented in Table 5 include two country-level indicators of income inequality (TOP20 and RATIO) as predictors of health. In Equations (1), (1a), (3) and (3a) we let physical health be a function of the individual-level variables plus TOP20 and RATIO, respectively. In Equations (2), (2a), (4) and (4a) we include interaction terms between the indicators of income inequality at the country-level and wealth to examine the hypothesis that the association between household wealth and health tends to intensify with increasing inequality in the distribution of economic resources.

The findings in Equations (1) and (3) do not provide support for the hypothesis that the level of health of the population tends to be higher in more egalitarian societies than in societies with greater inequality as evident from the insignificant effects of TOP20 and RATIO on the intercept. The coefficients estimates for Equations (2) and (4), however, lend support for the thesis that greater equality weakens the tie

Table 5
Effects of individual-level and country-level indicators of income inequality on physical health index, coefficients (std. errors) obtained from HLM analysis.

	Models							
	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)
Individual level effects								
Intercept	86.953** (0.777)	87.967** (0.662)	86.952** (0.736)	87.965** (0.662)	86.953** (0.75)	87.966** (0.661)	86.952** (0.721)	87.965** (0.661)
Wealth (%)	0.050** (0.007)	0.051** (0.004)	0.050** (0.005)	0.052** (0.004)	0.050** (0.007)	0.051** (0.005)	0.050** (0.006)	0.052** (0.004)
Income (%)	0.016** (0.002)	0.001 (0.002)	0.016** (0.002)	0.001 (0.002)	0.016** (0.002)	0.0012 (0.002)	0.016** (0.002)	0.0012 (0.002)
Age	−0.361** (0.005)	−0.350** (0.005)	−0.361** (0.005)	−0.350** (0.005)	−0.361** (0.005)	−0.350** (0.005)	−0.361** (0.005)	−0.350** (0.005)
Male	2.650** (0.092)	2.500** (0.1)	2.650** (0.092)	2.500** (0.1)	2.650** (0.092)	2.500** (0.1)	2.650** (0.092)	2.500** (0.1)
Low education	−1.681** (0.109)	−1.618** (0.121)	−1.681** (0.109)	−1.618** (0.121)	−1.682** (0.11)	−1.618** (0.122)	−1.682** (0.11)	−1.618** (0.122)
High education	0.727** (0.13)	0.409** (0.148)	0.729** (0.13)	0.412** (0.148)	0.727** (0.13)	0.409** (0.148)	0.729** (0.13)	0.411** (0.148)
Immigrant	0.175 (0.156)	−1.221** (0.176)	0.173 (0.156)	−1.224** (0.176)	0.1751 (0.156)	−1.221** (0.176)	0.1737 (0.156)	−1.223** (0.176)
Living with partner	0.384** (0.11)	0.511** (0.121)	0.386** (0.11)	0.513** (0.121)	0.384** (0.11)	0.511** (0.121)	0.385** (0.11)	0.513** (0.121)
Country level effect								
On the intercept								
TOP 20	−0.178 (0.191)	−0.199 (0.214)	−0.482* (0.218)	−0.215 (0.214)	–	–	–	–
RATIO	–	–	–	–	−0.529 (0.395)	−0.442 (0.467)	−1.081* (0.453)	−0.486 (0.468)
On wealth								
TOP 20	–	–	0.005** (0.002)	0.003. (0.001)	–	–	–	–
RATIO	–	–	–	–	–	–	0.009* (0.004)	0.004 (0.003)
N (individual)	65,955	46,600	65,955	46,600	65,955	46,600	65,955	46,600
N (country)	16	15	16	15	16	15	16	15

Note: Standard errors are in parentheses; $^{**}p < 0.01$, $^{*}p < 0.05$, $_{\cdot}p < 0.10$.
Wealth and age are centered around their grand mean; The second-level predictors are centered around their grand mean. Omitted categories: female = 0; intermediate education = 0; not immigrant = 0; is not living with partner = 0. Wealth slope is allowed to vary across countries. Equations (1a), (2a), (3a), and (4a) are estimated without the US.

between wealth and health as evident from the significant (and positive) effect of TOP20 and RATIO on the slope. This effect (as well as the negative effect on the intercept), however, can be mostly attributed to the uniqueness of the American case as evident from the decline in the size and significance of the interaction term coefficients in Equations (2a) and (4a). The US is a society characterized by high level of income inequality and a strong association between wealth and health. Once the US is excluded, the effect of income inequality on health and on the tie between wealth and health declines considerably and is no longer statistically significant.

Conclusions

The major goal of the present research was to examine within a cross-national comparative framework the "wealth–health gradient" thesis. More specifically, the aim of the study was to examine the following questions: first, whether individuals' economic resources (i.e. income and wealth) are positively associated with personal health; second, whether country's economic resources are likely to enhance the health of the population and country's unequal distribution of economic resources are likely to decrease population's health; third, whether the positive association between personal wealth and health is likely to be weaker in rich economies than in poorer countries and in egalitarian countries as compared to countries characterized by unequal income distributions.

Our analysis focuses on data from 16 national probability samples of the population age fifty and over. The analysis provides firm support for the "wealth–health gradient" hypothesis but limited support for the "income–health gradient". That is, consistent with previous studies the data reveal that in all countries personal wealth is positively associated with health, net of socio-demographic attributes and even net of income. Although the causal relationship is beyond the scope of this analysis the findings suggest that wealthier persons tend to be healthier than the less economically endowed. We should also note that the findings, according to which the effect of wealth on health is stronger than that of income, pertain to middle-aged and older populations, many of whom are retired. These findings may not apply to younger populations, which are less likely to have accumulated wealth and are more dependent on current income.

The findings support the thesis that health of the population tends to increase with country's economic resources. That is, in line with previous studies the analysis reveals that average health of the population in richer countries is significantly higher and better than the average health of the population in poorer countries. However, the findings do not support the argument that availability of economic resources in a country weakens the tie between wealth and health and decreases health disparities between rich and poor people. The analysis that focuses on the impact of income inequality in society (as an indicator of egalitarianism) does not support the thesis that country's income inequality affects average health of the population. The analysis reveals that most of the effect of income inequality on the wealth–health gradient can be attributed to the uniqueness of the US. It appears that in the other countries the positive association between wealth and health is quite similar regardless of differences in income inequality. It is our hope, thus, that in the future the findings reported in the present study regarding the wealth–health gradient would be re-examined and re-evaluated across a wider range of more heterogeneous countries than the sixteen countries included in this analysis.

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Appendix A. List of countries, source of data, year data were collected, and number of households included in the national sample

Country	Data source	Year of data collection	Wave	Number of cases
Austria	SHARE	2004	1	1849
Germany	SHARE	2004	1	2942
Sweden	SHARE	2004/05	1	2997
Netherlands	SHARE	2004	1	2870
Spain	SHARE	2004	1	2354
Italy	SHARE	2004	1	2508
France	SHARE	2004/05	1	3052
Denmark	SHARE	2004	1	1615
Greece	SHARE	2004/05	1	2680
Switzerland	SHARE	2004	1	961
Belgium	SHARE	2004/05	1	3699
Israel	SHARE	2005/06	1	2493
Czech Republic	SHARE	2006/07	2	2749
Poland	SHARE	2006/07	2	2425
United Kingdom	ELSA	2002/03	1	11,406
United States	HRS	2004	7	19,355
Total	–	–	–	65,955

Appendix B. List of individual and household level variables included in the analysis, definitions and descriptive statistics (percent, mean, and std. deviation)

Variables	Definition	Percent or mean (std. deviation)
Physical Health Index	Percentages Physical Health Index includes number of limitations with activities of daily living, number of mobility, arm function and fine motor limitations, number of chronic diseases and number of symptoms	86.02 (13.49)
Wealth	Household's net worth: sum of real and net financial assets, PPP-adjusted, in Euro	296122.93 (905149.35)
Income	Household total non-asset income, PPP-adjusted, in Euro	39383.92 (58541.54)
Age	Respondent age in years	65.78 (10.47)
Immigrant status:	Main respondent was born outside (survey's) country = 1, native born = 0	
Immigrant		10.2
Native born		89.8
Gender:	Respondent gender: male = 1, female = 0	
Male		44.5
Female		55.5
Education:	Respondent education level: low than high school education = 1; academic education = 1; high school education = 0	
Low than high school		44.5
High school		36.7
Academic		18.8
Respondent partnership status:	Living with partner = 1; living alone = 0	
Living with partner		68.6
Living alone		31.4

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