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Democracy and Self-Rated Health across 67 Countries: A Multilevel Analysis

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Abstract

Existing research has found a positive association between countries' level of democratic governance and the health of their populations, although that research is limited by the use of data from small numbers of high-income countries or aggregate data that do not assess individual-level health outcomes. We extend prior research by using multilevel World Health Survey (2002-2004) data on 313,554 individuals in 67 countries, and find that the positive association between democratic governance and self-rated health persists after adjusting for both individual- and country-level confounders. However, the mechanisms linking democracy and self-rated health remain unclear. Individual-level measures of socioeconomic status, and country-level measures of economic inequality and investments in public health and education, do not significantly mediate the association between democratic governance and self-rated health. The persistent association between democratic governance and health suggests that the political organization of societies may be an important upstream determinant of population health.

Keywords

World Health Survey; global health; democracy; political epidemiology; corruption; self-rated health

A growing body of evidence suggests that countries with more democratic governments—as indicated by open and free elections, protection of civil liberties, lower levels of corruption, and freedom of the press—are associated with lower rates of mortality, healthier behaviors, and better self-rated health (Bobak et al., 2006; Ciccone et al., 2014; Klomp & de Haan, 2009). The importance of this research is clear; encouraging the development of

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stronger and more vibrant democracies that safeguard human rights may also improve population health (Mann et al., 1994). Existing research on the association between democracy and population health, however, seldom examines both country-level and individual-level mediators, or tests whether living in more democratic countries benefits some groups more than others. A more rigorous understanding of the association between democratic governance and individual health could clarify the role of political factors in shaping global health disparities.

Health, Democracy, and their Mediators

A country's political organization may appear far removed from individuals' daily lives. Nevertheless, political institutions have substantial financial, organizational, and policy resources to bring to bear on people's health. Democracies, in particular, may be well poised to promote health. Governments that allow free and open elections and that permit the press to openly scrutinize political decisions may be more responsive to popular demands for investments in education, public health, or social programs that reduce the harm associated with unemployment or poverty (Holmberg & Rothstein, 2011). Further, more democratic governments may seek to improve equality and to ensure that public benefits and opportunities for social mobility are shared widely, regardless of age, gender, race/ethnicity, religion, or socioeconomic status. Indeed, more democratic governments may support equal opportunity (including equal opportunities for health) by promoting suffrage for women and minorities, protecting civil liberties, and providing equal protection for all groups under the law (Mann et al., 1994).

Research that finds a positive association between democratic governance and population health seldom examines the mechanisms that may drive that association (Ciccone et al., 2014). We test three sets of mediators that might explain the association between democratic governance and health. Although the potential benefits of democracy are diverse and multifaceted, we focus on intermediate factors that are often studied in population health (even if those studies do not consider political context), and that draw on the strengths of our data.

First, we examine whether income inequality mediates the association between democracy and individual-health. More democratic nations may seek to reduce economic inequality by imposing progressive tax rates, regulating monopolies, implementing trade policies, or reducing corruption (Reuveny & Li, 2003). In turn, reduced economic inequality may result in better health by strengthening the middle and working classes, alleviating perceptions of relative deprivation, and increasing social cohesion (Kawachi & Kennedy, 2002). Of the studies using international data, more than half find an inverse association between inequality and health (Wilkinson & Pickett, 2006).

Second, we examine whether public health infrastructures mediate the association between democracy and individual-level health. In response to public demand, more democratic and less corrupt nations may prioritize improvements in the public health infrastructure (Holmberg & Rothstein, 2011). Such investments should result in improved sanitation, increased rates of vaccination, support for hospitals, the education and retention of doctors

and nurses, and the effective regulation of food and drug safety. In turn, basic improvements in the public health infrastructure can result in substantial reductions in morbidity and mortality (Cutler & Miller, 2005; Stern & Markel, 2005).

Third, we test whether socioeconomic wellbeing mediates the association between democratic governance and individual-level health. At the country-level, more democratic nations may invest in education because the ability to make reasoned decisions, consider different positions, form opinions, and cast informed votes are central to being an active participant in a democratic society (Ansell, 2008; Stasavage, 2005). Further, education promotes the knowledge and skills that support a strong labor force and a productive economy. Efforts to increase education—including investments in primary and secondary education, the promotion of literacy, and mandatory schooling laws—should result in a more productive labor force, higher standards of living, and, ultimately, better health (Nordahl et al., 2014; Winkleby et al., 1990).

At the individual-level, three indicators of socioeconomic status (SES) may mediate the association between democracy and health: educational attainment, employment in the paid labor force, and asset ownership. More democratic countries may promote higher levels of individual education as a result of greater investments in the educational infrastructure, as described above. By promoting education and the possibility of social and economic advancement through work and entrepreneurship (rather than relying on nepotism or bribes), more democratic countries may support high rates of participation in the paid labor force, improved standards of living, and the acquisition of personal wealth and assets (Krueger & Burgard, 2011). Education, employment, and assets have all been linked to improved health and health behaviors across countries and over time (Huisman et al., 2005; Pampel et al., 2010).

Variation in the Association between Democracy and Health across SES Groups

Socioeconomic disparities in health persist in modern welfare states (Mackenbach, 2012), but little research examines whether those disparities depend on the level of democratic governance across a more diverse array of nations. On one hand, socioeconomic disparities in health may be narrower in more democratic countries. Democratic governments may be more likely to provide safety-nets that subsidize food and shelter for the poor, temporary income to the unemployed, and universal access to healthcare—factors which might reduce the health costs associated with having limited socioeconomic resources (Acemoglu & Robinson, 2000; Stucker et al., 2010). Further, greater freedom of the press may result in widespread knowledge across SES groups about how to promote health. In sum, more democratic governments may be particularly effective at attenuating SES disparities in health by benefiting those with the fewest socioeconomic resources.

An alternate perspective suggests that socioeconomic disparities in health may be wider in more democratic countries. More democratic countries may promote meritocracy (rather than corruption or nepotism), which may allow those with higher SES to reap the greatest possible benefits for health. Some evidence suggests that democracies spend more money on

education and health than non-democracies, but those investments generally benefit middle- and upper-class groups who often vote at higher rates than those with fewer socioeconomic resources (Moffitt, 2015; Ross, 2006). Although knowledge about how to promote health may be widely available in democratic countries, those with higher SES may be better poised to take advantage of the knowledge and resources necessary to pursue better health (Link & Phelan, 1995; Pampel et al., 2010). Implicit in our discussion is the null hypothesis: the socioeconomic gradient in health may be unassociated with variation in democratic governance across nations.

Aims

Our first aim is to examine the association between democratic governance and individual health. We advance existing research by using multilevel data from 67 countries that represent all regions of the world. Existing research typically relies on either aggregate data that cannot consider individual-level outcomes (i.e., Batniji et al., 2014; Besley & Kudamatsu, 2006; Franco et al., 2004; Klomp & de Haan, 2009; Mackenbach et al., 2013; Ross, 2006) or political transitions in single countries that may not generalize to other contexts (i.e., Álvarez-Dardet & Franco-Girald, 2006; Cockerham, 2000). Our second aim is to examine whether country-level characteristics (i.e., income inequality and investments in education and public health) and individual-level characteristics (i.e., education, employment, and assets) mediate the association between democratic governance and individual health. Existing research has examined country-level mediators (Besley & Kudamatsu, 2006; Klomp & de Haan, 2009), but has not simultaneously considered individual-level mediators. Finally, our third aim is to examine whether democratic governance moderates the association between individual-level SES and health. We take advantage of our multilevel data by testing cross-level interactions between the level of democratic governance and three individual-level measures of SES.

DATA AND METHODS

The World Health Survey (WHS), conducted between 2002 and 2004, provides nationally representative, individual-level data on respondents aged 18 and older from all regions of the world (Üstün et al., 2003). The WHS was conducted in 70 countries; each country implemented the survey with supervision from the World Health Organization. We excluded data from three countries due to extremely high rates of missing data and implausible responses to multiple survey items (see Appendix Table 1 for a list of countries included in the analyses, by region of the world). Combining records from the 67 countries results in a sample of 313,554 respondents.

Individual-Level Variables

Our outcome variable is self-reported health, as measured on an ordinal scale with categories for excellent (=4), very good, good, fair, and poor (=0). Self-reported health provides a global overview of health. Subjective reports of health may be more useful than reports of specific medical conditions in contexts where few adults have regular access to physicians. Although the meaning of self-rated health may vary across nations, it is predictive of prospective mortality both in high- and low-income countries (Frankenberg &

Jones, 2004; Jylha, 2009; Olgiati et al., 2012). Further, self-rated health is valid in high- and low-income nations and in all regions of the world (Subramanian et al., 2010). All analyses adjust for sex and age as individual-level confounders. Sex is coded dichotomously. Age is continuous and is centered at 4.0 decades. We include age-squared in our models to capture any nonlinear association between age and health.

We include three individual-level measures of SES. The highest level of education completed is assessed on a seven-point scale that ranges from no formal schooling to a post-graduate degree. Educational attainment is centered at 3.4 (the grand mean), which is between primary school completion (=3) and secondary school completion (=4). We create a measure of household wealth by taking the first dimension of a principal components analysis of a series of 15 items that households may own (Filmer & Pritchett, 2001). Some of the items queried in low-income countries (e.g., a clock, a bucket, number of tables) differ from those asked in high-income countries (e.g., a DVD player, a video camera, number of televisions), and the meaning of ownership of different items varies across countries. Thus, we estimate the principal components analysis separately for each country and then standardize the score within each country to have a mean of 0 and a standard deviation of 1. Employment is measured dichotomously and indicates those who work in the paid labor force (=1) versus those who do not work or who work in the informal economy (=0). The share of workers in the paid labor force varies across countries, but typically signals access to regular income and employment-based social networks (Krueger & Burgard, 2011).

Country-Level Variables

We use factor analysis to create the country-level measures for democracy, public health, and education (detailed below). Each of those measures reflects a broad, multifaceted concept that cannot be measured directly. We use multiple indicators for each of our factor variables, because each indicator provides only partial insight into the concept of interest. Thus, factor analysis allows us to measure the underlying concepts of democracy, public health, or education more precisely than the use of any single observed indicator (see Klomp & de Haan, 2009).

Our democracy variable comes from a factor analysis of 7 indicators that capture different dimensions of political functioning (Davenport, 2007), an approach used in prior research (Klomp & de Haan, 2009). The indicators are described below, and include the Polity Version IV-Democracy Index, Polity Version IV-Autocracy Index, Corruption Perception Index, Freedom House Political Rights Index, Freedom House Civil Liberties Index, Political Terror Scale, and an index that assesses the role of military officers in the government. We standardize the factor to have a mean of 0 and a standard deviation of 1 in the country level data; Appendix Table 2 shows the factor loadings. Separate analyses (not shown) find that each indicator of political functioning is individually associated with individual health in the expected direction, but our estimates are more efficient when using the factor score.

The Polity Version IV-Democracy Index rates countries on three central elements of democracy: the ability of citizens to effectively influence policies and government leaders,

the existence of institutionalized constraints on executive power, and the guarantee of civil liberties to individuals. The Polity Version IV-Autocracy Index rates countries on their level of autocracy, based on the degree to which countries limit competitive political participation and have few institutionalized constraints on executive power. The democracy and autocracy indices are measured with different data elements, so nations can have both democratic and autocratic characteristics (Marshall & Jaggers, 2007). Both scales range from 0 (low levels of democracy or autocracy) to 10 (high levels of democracy or autocracy).

The Corruption Perception Index (CPI) indicates the frequency and severity with which residents are required, or perceive that they are required, to offer bribes or kickbacks to government officials in order to obtain permits, avoid taxes, or influence policies (Lambsdorff, 2003). The CPI ranges from 0 to 10, with high scores indicating higher levels of corruption. The Freedom House Political Rights Index indicates whether elections are free and fair, individuals can organize into different political parties, and the level of government transparency. The Freedom House Civil Liberties Index measures the presence of a free and independent media, opportunities for public assembly, academic and religious freedom, protections from political terror, and the presence of an independent judiciary. Both Freedom House (2008) scales range from 1 (most freedom) to 7 (virtually no freedom).

The Political Terror Scale indicates the level of state-sanctioned political violence, with an emphasis on violence that takes place within a nation's own territorial borders. The index is comprised of two sub-scales; one draws on reports from the U.S. State Department and the other relies on reports from Amnesty International (Gibney et al., 2008). Each sub-scale ranges from 1 to 5, with high scores indicating higher levels of civil and political rights violations. Because the two sub-scales are highly correlated (r=0.80), and because each subscale relies on different sources to assess the same concept, we take the mean of the two items.

We assess the role of military officers in the government by using two items from the Database of Political Institutions (Beck et al., 2001): the first dichotomous variable indicates whether the defense minister is a current military officer, and the second dichotomous variable indicates whether the chief minister is a current military officer. Ministers are considered military officers if they have not formally retired from military office before assuming political office. We sum the two dichotomous items with higher values indicating greater involvement between military and political administrations.

We examine three country-level variables that may mediate the association between political functioning and health. First, the Gini index is a measure of economic inequality that ranges from 0 (no inequality) to 100 (totally unequal) (Milanovic, 2013). Second, the public health variable comes from a factor analysis of 9 items that reflect major efforts to improve the health of the population; the factor loadings are shown in Appendix Table 3. The items include the percentage of births attended by a healthcare professional; the number of physicians and nurses per 1,000 people; the percentage of children receiving diphtheria, pertussis, tetanus and measles vaccinations; the share of GDP per capita spent on health; the percentage of pregnant women receiving prenatal care; the share of all government

expenditures that are spent on health; and the percentage of the population with access to improved sanitation facilities. Third, the country-level education variable comes from a factor analysis of 6 items that indicate educational inputs or outcomes in each population; the factor loadings are shown in Appendix Table 4. The items include the percentage of government expenditures spent on education; the ratio of students to teachers in primary school and secondary school; literacy rates for men and women; and the average years of education among those aged 15 to 19. Items for the public health and education factors come from the World Health Organization (2015) and the World Bank (2015). Both factors are standardized to have a mean of 0 and a standard deviation of 1 in the country-level data.

We adjust for two country-level confounders in our analyses. First, purchasing power parity adjusted gross domestic product per capita (GDP) comes from the Penn World Table (Heston et al., 2012). We log our measure of GDP to account for the diminishing returns of economic development to health. Economic development may drive the development of democratic institutions (Burkhart & Lewis-Beck, 1994) and simultaneously impact health (Preston, 1975). Second, we include dummy variables for global region, with indicators for Africa, Eastern Mediterranean, Southeast Asia, Western Pacific, Europe (the referent), and South and Central America. Appendix Table 1 shows the countries in each region. Adjusting for region helps to account for any unobserved region-specific confounders, and region-specific factors (e.g., language, culture) that shape subjective ratings of health. We cannot include dummy variables for each country because they would be perfectly collinear with our country-level variables (e.g., the democracy factor), which could no longer be included in our models.

We use country-level data from 2003, with one exception. We use 2005 data for the Corruption Perception Index, because it was routinely missing in earlier years. In the rare instances where 2003 data are missing for a variable for a specific country, we use data from 2002 or 2004 so that our country-level data still align with our individual-level data. In general, country-level data were very highly correlated across sequential years (correlations for individual variables are routinely above $r = 0.95$ across years) and using observed data from nearby years seemed less likely to result in measurement error than imputing those values.

Analysis

We use Mplus software to estimate multilevel ordered logistic regression models that predict respondents' self-rated health, where individuals are nested within countries (Hedeker, 2007; Muthén & Muthén, 2012). Some of our models test cross-level interactions and allow for a random intercept, a random slope, and a random intercept by slope covariance. To ensure that our random intercept and random intercept by slope covariance take meaningful values, we center age, wealth, and individual-level education, and use dummy coding for other variables, so that 0 takes a meaningful value in each case (Snijders & Bosker, 2012).

We use multiple imputation to account for missing data. We have very low rates of missing data for country-level variables; the Gini index is missing for Myanmar and the United Arab Emirates, and the GDP is missing for Myanmar. At the individual-level, employment status is missing for 13% of the observations and wealth is missing for 7% of the observations,

with the remaining variables missing for about 3% of observations. Multiple imputation assumes that data are missing at random after conditioning on other observed variables in the data set, a more plausible assumption than made by listwise deletion (Little & Rubin, 2002). We use 10 multiply-imputed data sets. Because final survey weights were missing for over one third of our data, we exclude them from our analyses. Separate analyses that used imputed survey weights for those with missing weights found virtually identical point estimates. We test for differences in coefficients across models using standard methods (Brame et al., 1998).

RESULTS

Table 1 presents means and percentages of study variables by self-rated health. At the individual-level, being male, younger, more educated, more wealthy, and working in the paid labor force are all associated with better self-rated health. The democracy factor and GDP per capita are also positively associated with health. There are notable differences in the distribution of self-rated health across regions. For example, living in Europe, Southeast Asia, or the Eastern Mediterranean are inversely associated with better self-rated health, whereas living in the Western Pacific is positively associated with better self-rated health.

Table 2 presents coefficients from the hierarchical ordered logistic regression models that predict self-rated health. Model 1 adjusts for GDP per capita, region, sex, age, and age-squared, and shows that a one-standard deviation increase in the democracy factor is associated with 1.37 ($=e^{0.317}$) times the odds of better self-rated health. Models 2 through 6 include potential mediators of the association between democracy and self-rated health. Model 2 shows that a one unit increase in the Gini index, our measure of income inequality, is associated with 3% ($=[e^{-0.032})-1]*100$) lower odds of better self-rated. Economic inequality explains 21% (=[.317−.250]/.317*100) of the association between democracy and self-rated health compared to Model 1, although the slope for the democracy factor is not significantly different in Model 2 compared to Model 1 ($z = 0.46$; two-tailed $p = 0.64$). Models 3 and 4 include the country-level public health and education factors, respectively, and show that they are not associated with self-rated health.

Model 5 includes the individual-level SES variables, and shows that a one standard deviation increase in wealth is associated with 1.14 ($=e^{0.128}$) times the odds of better self-rated health. Further, a one degree increase in education is associated with 1.09 ($=e^{0.086}$) times the odds of better self-rated health, and working for pay is associated with 1.32 ($=e^{0.277}$) times the odds of better self-rated health. However, the slope for the democracy factor in Model 5 is not different from the slope in Model 1 ($z = -0.01$; two-tailed $p = 0.99$). Model 6 includes all of the mediators simultaneously and finds that the Gini index and the individual-level measures of SES remain associated with self-rated health. Taken together, the mediators explain 9% (=[.317−.288]/.317*100) of the association between democracy and self-rated health compared to Model 1, although the slope for the democracy factor is not significantly different in Model 6 compared to Model 1 ($z = 0.19$; two-tailed $p = 0.85$).

Table 3 presents random-coefficient models that allow the association between the individual-level SES variables and self-rated health to vary across countries, and include

cross-level interactions between the individual-level SES variables and the democracy factor. We test interactions with each individual-level SES variable separately, to reduce the risk of multicollinearity, which is common in interaction models. Model 1 shows that the random slope for wealth (at the bottom of the table) is statistically significant, indicating that the association between wealth and self-rated health varies across countries. The interaction between wealth and the democracy factor shows that the association between wealth and self-rated health is slightly more positive in countries with higher values on the democracy factor, although the interaction term is small in magnitude and not statistically significant.

Model 2 shows that the random slope for education is significant. The interaction between education and the democracy factor shows that the association between education and self-rated health becomes somewhat more positive in countries that score higher on the democracy factor; but the interaction term is small and not statistically significant. Model 3 shows that the random slope for employment status is not significant. The interaction term suggests that employment is associated with slightly better health in countries that score higher on the democracy factor, although the interaction term is small and not statistically significant. Notably, the slope for the democracy factor (i.e., when employment status=0) is not statistically significant. However, the magnitude of the slope for the democracy factor is largely unchanged when compared to models that exclude the interaction (see Table 2, Model 5) and the standard error is larger, suggesting that the democracy factor is collinear with the interaction between democracy and employment status. Separate analyses (not shown) that exclude the interaction continue to find a strong, positive, and significant association between the democracy factor and self-rated health.

DISCUSSION

Our results demonstrate a strong positive association between democratic governance and better individual health, even after adjusting for individual-level (i.e., age, age-squared, and sex) and country-level (i.e., GDP per capita, region) confounders (aim 1). Although many prior studies have found a significant relationship between political functioning and health (Besley & Kudamatsu, 2006; Franco et al., 2004; Klomp & de Haan, 2009), others have found that political functioning has mixed or null associations with health depending on the larger global context, the time period examined, and the country's economic development (Batniji et al., 2014; Mackenbach et al., 2013; Ross, 2006). By using multilevel data that represent all regions of the world and that allow us to adjust for individual- and country-level confounders, our findings provide further support for the association between democratic governance and health.

Our study is the first to consider both country-level and individual-level mediators of the association between democracy and health (aim 2). Consistent with existing research (Kondo et al., 2012; Wilkinson & Pickett, 2006), the Gini index—our measure of country-level economic inequality—was inversely and significantly associated with self-rated health. Economic inequality explained about 21% of the association between democracy and self-rated health, although the reduction in the slope for the democracy factor was not significant. Prior research finds that the association between economic inequality and health varies across calendar periods (Kondo et al., 2012; Wilkinson & Pickett, 2006). Thus, future

research with time-series data might examine whether economic inequality more strongly mediates the association between democracy and health in more recent time periods.

Country-level measures of investments in public health or education were also unable to explain the association between democracy and health. Perhaps the benefits of country-level investments in education and public health primarily accrue to small subsets of the population (e.g., children and adolescents) that are not available in our data. Alternately, our results may suggest the presence of the "prevention paradox," wherein investments in education or public health that provide large benefits to population health, might have little impact on the health of any single individual (Rose, 2001). Besley & Kudamatsu (2006) find that compared to non-democratic nations, democracies are much more likely to spend more on health and to invest in sanitation, clean water, and vaccinations. But, consistent with our findings, Klomp and de Haan (2009) find no evidence that country-level public health interventions, education, or economic inequality mediate the association between democracy and health.

Our results show that individual-level SES measures—educational attainment, employment, and assets—do not mediate the association between democratic governance and self-rated health. Nevertheless, individual-level education, wealth, and employment are each positively associated with self-rated health, even though country-level investments in education are not. Country-level investments in education may provide small benefits to numerous individuals. But the individual-level measures of SES reflect realized levels of education, wealth, and employment for specific individuals, which likely pay greater dividends for health (Krueger & Burgard, 2011). None of our proposed mediators significantly explain even a portion of the association between democracy and health. Our findings mirror those of Klomp and de Haan (2009), who use aggregate data from 171 countries over a 5-year period, and find that country-level income inequality and investments in health and education, do not mediate the association between democracy and health. Future research should continue to search for mediators, to clarify the mechanisms that link democracy to better health.

Our third aim examined whether SES disparities in health vary across levels of democracy. Although both democracy and individual-level measures of SES are persistently associated with health, we find no significant interactions between democracy and our SES variables. Our findings are consistent with findings that socioeconomic disparities persist even in contemporary welfare states (Mackenbach, 2012). Safety nets such as unemployment insurance, food assistance, subsidized housing, tax credits, or medical care may be more common in more democratic countries (Acemoglu & Robinson, 2000), but those programs may not be adequate to reduce socioeconomic disparities in health. Indeed, over time, some nations may shift welfare spending away from the most vulnerable populations and toward middle income, employed, or married recipients (Moffitt, 2015; Ross, 2006). Thus, higher levels of democracy are associated with better health for all residents of a country, but democratic governance cannot explain the SES disparities in health that are observed in both high-income and low-income nations (Mackenbach, 2012; Subramanian et al., 2010). Separate analyses (not shown) also failed to find support for interactions between sex and the level of democracy.

Strengths and Limitations

The strengths of our data include the use of a large, multilevel data set that includes countries from all regions of the world and all levels of economic development. Our analyses include both individual- and country-level variables, and test for cross-level interactions. Ancillary analyses (not shown) adjusted for union status (married or cohabiting versus no partner in the household), but the variable was not associated with self-rated health in any of our models. Further, separate models also found no support for an interaction between the democracy factor and GDP.

Our study is also marked by several limitations. First, the inclusion of such diverse countries in our analyses increases the external validity of our results, but also raises the specter of confounding on unobserved variables. Observational studies cannot rule out confounding from unobserved variables, but in separate analyses, we adjusted for the percent of the population aged 65 or older, the percent of the population younger than age 15, and the national unemployment rate. However, those variables were not significant in any of our models, whether entered singly or in combination with other covariates. Unfortunately, we can adjust for only a limited number of country-level confounders in a single model, due to our relatively modest number of country-level degrees of freedom. We have just slightly more than the minimum acceptable number of country-level units necessary to ensure that our standard errors are unbiased (Maas & Hox, 2005).

Second, subjective ratings of health might complicate international comparisons and may not be directly comparable to outcome measures used in prior studies, such as infant mortality rates or life expectancy at birth. We adjust for region to account for cultural or linguistic factors that vary across regions and that may shape subjective reports of health. Some studies have used self-rated health to make cross-country comparisons (Holmberg & Rothstein, 2011), and evidence suggests that self-rated health is predictive of mortality in both high- and low-income countries (Frankenberg & Jones, 2004; Jylha, 2009; Olgiati et al., 2012). Further, prior analyses suggest that the self-rated health measure is relatively valid, regardless of national income or region of the world (Subramanian et al., 2010). Although mortality risk would likely be a more valid outcome than self-rated health, conducting surveys that link to prospective mortality in diverse countries may not be feasible.

Third, although we have individual-level measures of SES and country-level indicators of investment in education, we do not have individual-level measures that correspond to country-level inequality or public health investments. Although the WHS collects a broad slate of variables linked to public health, those variables often vary systematically across high-income (e.g., access to emergency and preventive health care) and low-income (e.g., malaria prevention efforts, access to flush toilets, individual receipt of vaccinations) countries. Further, the WHS does not include information on perceptions of relative deprivation.

Conclusion

The persistent association between democratic functioning and population health is important given rapid changes in human and political rights occurring throughout the Middle East and parts of Asia. Our results suggest that supporting the development of democracy may pay dividends for population health in addition to civil and political rights. Notably, transitions to democracy can be chaotic periods marked by political, social, and military upheaval, and there are few effective tools available to encourage the development of democracy. Our findings, however, suggest that democracy may be an important "upstream" determinant of population health, and that researchers and policy makers might work together to identify strategies to promote vibrant and stable democracies, while taking steps to limit the adverse effects of political change.

Appendix

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HIGHLIGHTS

- We use multilevel World Health Survey data with individuals nested within countries
- Democracy has a strong, positive association with better self-rated health
- Country-level variables do not mediate the democracy and health association
- Individual-level SES do not mediate or modify the democracy and health association

Table 1

Range, means, and percentages of covariates, by self-rated health, World Health Survey.

	Range	Poor	Fair	Good	Very Good	Excellent
Individual-Level Characteristics						
Male, %	0 to 1	35.7	36.5	39.8	45.0	50.4
Age in decades (centered at 4.0)	1.8 to 9.0	1.5	1.3	0.6	−0.1	−0.5
Wealth[a]	−5.68 to 12.36	−0.39	−0.32	−0.11	0.06	0.13
Education, centered	−2.44 to 3.56	−0.78	−0.65	−0.16	0.14	0.19
Working for Pay, %	0 to 1	28.0	40.7	55.0	64.2	66.2
Country-Level Characteristics						
Democracy factor[b]	−1.94 to 1.03	−0.12	−0.15	−0.07	0.04	0.06
GDP per capita, $	148 to 61,543	8,462	7,910	8,714	10,644	10,909
Gini index	23.7 to 61.4	40.3	40.8	41.4	40.9	40.4
Public health factor[b]	−2.30 to 1.08	0.02	−0.09	0.00	0.05	−0.06
Education factor[b]	−3.23 to 0.63	−0.06	−0.10	0.01	0.04	−0.05
Region, %						
Europe	0 to 1	32.4	28.1	26.6	26.6	25.1
Africa	0 to 1	24.9	25.0	19.8	18.7	28.2
Southeast Asia	0 to 1	13.8	15.3	12.0	12.7	10.6
Western Pacific	0 to 1	3.7	7.0	12.2	13.7	12.1
South & Central America	0 to 1	12.9	17.7	23.8	23.0	18.0
Eastern Mediterranean	0 to 1	12.3	6.9	5.6	5.3	5.9
Number		3,787	22,120	86,015	130,263	71,370
Percent		1.2	7.1	27.4	41.5	22.8

N=313,554

[a] Wealth has a mean=0 and a standard deviation=1 within each country.

[b] The country-level factor variables are standardized (mean=0, standard deviation=1) in the country-level data.

Table 2

Ordered logistic regression coefficients (standard errors) from hierarchical model of self-rated health, World Health Survey.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Country-level variables						
Democracy factor	0.317*** (0.099)	0.250* (0.104)	0.334** (0.113)	0.315** (0.100)	0.319** (0.102)	0.288* (0.120)
Gini index		−0.032* (0.013)				−0.036** (0.014)
Public heath factor			−0.076 (0.154)			−0.243 (0.154)
Education factor				0.034 (0.079)		0.177 (0.092)
GDP per capita	−0.012 (0.036)	0.096* (0.047)	−0.005 (0.019)	−0.014 (0.016)	−0.022 (0.017)	0.110* (0.052)
Region						
Europe	ref.	ref.	ref.	ref.	ref.	ref.
Africa	0.198 (0.186)	0.810** (0.309)	0.090 (0.281)	0.241 (0.195)	0.386* (0.175)	0.949* (0.460)
Southeast Asia	0.062 (0.326)	0.437 (0.402)	−0.044 (0.392)	0.097 (0.310)	0.222 (0.309)	0.470 (0.456)
Western Pacific	0.502 (0.313)	0.839** (0.297)	0.456 (0.288)	0.506 (0.307)	0.562 (0.311)	0.802** (0.305)
South & Central America	−0.097 (0.179)	0.701 (0.374)	−0.136 (0.193)	−0.089 (0.176)	0.007 (0.173)	0.797* (0.403)
Eastern Mediterranean	0.542 (0.491)	0.671 (0.415)	0.496 (0.508)	0.574 (0.482)	0.717 (0.481)	0.880* (0.393)
Individual-level variables						
Wealth					0.128*** (0.013)	0.128*** (0.013)
Education					0.086*** (0.022)	0.086*** (0.022)
Working for pay (=1)					0.277*** (0.025)	0.277*** (0.025)
Male (=1)	0.363*** (0.024)	0.363*** (0.024)	0.363*** (0.025)	0.363*** (0.024)	0.258*** (0.027)	0.258*** (0.027)
Age	−0.380*** (0.018)	−0.380*** (0.017)	−0.380*** (0.017)	−0.380*** (0.017)	−0.364*** (0.016)	−0.364*** (0.016)
Age-squared	−0.011*** (0.003)	−0.011*** (0.003)	−0.011*** (0.003)	−0.011*** (0.003)	0.007* (0.003)	0.007* (0.003)
Thresholds for cumulative logit						
First	−4.744*** (0.342)	−4.749*** (0.240)	−4.745*** (0.140)	−4.745*** (0.149)	−4.605*** (0.141)	−4.589*** (0.281)
Second	−2.646*** (0.321)	−2.651*** (0.213)	−2.646*** (0.097)	−2.647*** (0.109)	−2.497*** (0.097)	−2.482*** (0.264)
Third	−0.579 (0.314)	−0.584** (0.186)	−0.580*** (0.060)	−0.581*** (0.083)	−0.412*** (0.056)	−0.396 (0.262)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Fourth	1.507*** (0.318)	1.502*** (0.177)	1.507*** (0.040)	1.506*** (0.074)	1.696*** (0.029)	1.712*** (0.270)
Random intercept	0.352*** (0.067)	0.316*** (0.063)	0.351*** (0.066)	0.351*** (0.067)	0.362*** (0.068)	0.315*** (0.062)

N=313,554;

* p<0.05,

** p<0.01,

*** p<0.001

Table 3

Ordered logistic regression coefficients (standard errors) for cross-level interactions, World Health Survey.

	Model 1	Model 2	Model 3
Country-level variables			
Democracy factor	0.338*** (0.099)	0.319** (0.102)	0.302 (0.597)
GDP per capita	−0.014 (0.015)	−0.034* (0.016)	−0.031 (0.165)
Region			
Europe	ref.	ref.	ref.
Africa	0.176 (0.170)	0.409* (0.190)	0.143 (0.507)
Southeast Asia	0.020 (0.298)	0.219 (0.282)	−0.008 (0.528)
Western Pacific	0.495 (0.320)	0.611* (0.301)	0.427 (0.405)
South & Central America	−0.132 (0.157)	0.088 (0.176)	−0.179 (0.445)
Eastern Mediterranean	0.547 (0.475)	0.794 (0.477)	0.612 (0.534)
Individual-level variables			
Wealth	0.197*** (0.017)		
Wealth by democracy factor	0.011 (0.019)		
Education		0.167*** (0.022)	
Education by democracy factor		0.039 (0.032)	
Working for Pay (=1)			0.351** (0.111)
Work by democracy factor			0.043 (0.693)
Male (=1)	0.358*** (0.025)	0.335*** (0.025)	0.282*** (0.051)
Age	−0.377*** (0.017)	−0.355*** (0.017)	−0.381*** (0.017)
Age-squared	−0.003 (0.003)	−0.005 (0.003)	0.003 (0.005)
Thresholds for cumulative logit			
First	−4.786*** (0.150)	−4.769*** (0.145)	−4.763*** (1.613)
Second	−2.678*** (0.107)	−2.659*** (0.103)	−2.659*** (1.602)
Third	−0.594*** (0.064)	−0.574*** (0.061)	−0.583*** (1.590)
Fourth	1.509*** (0.028)	1.531*** (0.028)	1.513*** (1.578)

	Model 1	Model 2	Model 3
Random intercept	0.363*** (0.069)	0.376*** (0.073)	0.379** (0.139)
Random slope: Wealth	0.019*** (0.004)		
Random slope: Education		0.013*** (0.003)	
Random slope: Work			0.046 (0.029)
Random slope by intercept covariance	−0.019 (0.010)	−0.005 (0.010)	−0.037 (0.065)

N=313,554;

* p<0.05,

** p<0.01,

*** p<0.001

Appendix Table 1

Number of Respondents in each Country in the Analysis, By Region, World Health Survey, 2002-2004

Africa	**N**	**Europe**	**N**
Burkina Faso	4,948	Austria	2,384
Chad	4,870	Belgium	2,407
Comoros	1,836	Bosnia and Herzegovina	1,031
Congo	3,075	Croatia	993
Cote d'Ivoire	3,251	Czech Republic	949
Ethiopia	5,089	Denmark	2,448
Ghana	4,165	Estonia	1,020
Kenya	4,640	Finland	2,343
Malawi	5,551	France	2,294
Mali	4,886	Georgia	2,950
Mauritania	3,902	Germany	2,503
Mauritius	3,968	Greece	2,831
Namibia	4,379	Hungary	1,419
Senegal	3,461	Ireland	3,101
South Africa	2,629	Israel	4,924
Swaziland	3,117	Italy	2,719
Zimbabwe	4,290	Kazakhstan	4,499
		Latvia	929
Eastern Mediterranean		Luxembourg	2,166
Morocco	5,000	Netherlands	2,727
Pakistan	6,501	Norway	2,262
Tunisia	5,202	Portugal	2,845
United Arab Emirates	1,183	Russian Federation	4,427
		Slovakia	2,535
Southeast Asia		Slovenia	687
Bangladesh	5,942	Spain	17,952
India	10,687	Ukraine	2,860
Myanmar	6,045	United Kingdom	2,765
Nepal	8,820		
Sri Lanka	6,805	**South & Central America**	
		Brazil	5,000
Western Pacific		Dominican Republic	5,027
Australia	9,340	Ecuador	5,675
China	3,994	Guatemala	4,886
Laos	4,988	Mexico	38,746
Malaysia	6,145	Paraguay	5,288
Philippines	10,083	Uruguay	2,996
Vietnam	4,174		

Appendix Table 2

Standardized factor loadings (standard errors) for democracy factor.

Polity IV: Democracy	0.96 (0.01)
Polity IV: Autocracy	−0.85 (0.04)
Corruption Perception Index	−0.65 (0.07)
Freedom House: Political Rights	−0.99 (0.01)
Freedom House: Civil Liberties	−0.96 (0.01)
Political Terror Scale	−0.57 (0.08)
Ministry Involvement	−0.60 (0.08)

N=67

Appendix Table 3

Standardized factor loadings (standard errors) for the public health factor.

% of births attended	0.94 (0.02)
Physicians per capita	0.82 (0.04)
Nurses per capita	0.67 (0.08)
% of children receiving DTP vaccine	0.81 (0.05)
% of children receiving MCV vaccine	0.80 (0.05)
% of GDP per capital spent on health	0.69 (0.07)
% of pregnant women receiving prenatal care	0.83 (0.05)
% of govt. expenditures that go to health	0.52 (0.09)
% of pop. with access to improved sanitation	0.92 (0.02)

N=67

Appendix Table 4

Standardized factor loadings (standard errors) for the education factor.

% of govt. expenditures go to education	0.24 (0.13)
Students to teacher ratio: primary school	−0.75 (0.06)
Students to teacher ratio: secondary school	−0.63 (0.08)
% of adult females who are literate	1.00 (0.01)
% of adult males who are literate	0.98 (0.01)
Mean yrs. of education among those aged 15-19	0.72 (0.06)

N=67