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Article

Does gender inequity increase men's mortality risk in the United States? A multilevel analysis of data from the National Longitudinal Mortality Study

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A B S T R A C T

A number of theoretical approaches suggest that gender inequity may give rise to health risks for men. This study undertook a multilevel analysis to ascertain if state-level measures of gender inequity are predictors of men's mortality in the United States. Data for the analysis were taken primarily from the National Longitudinal Mortality Study, which is based on a random sample of the non-institutionalised population. The full data set included 174,703 individuals nested within 50 states and had a six-year follow-up for mortality. Gender inequity was measured by nine variables: higher education, reproductive rights, abortion provider access, elected office, management, business ownership, labour force participation, earnings and relative poverty. Covariates at the individual level were age, income, education, race/ethnicity, marital status and employment status. Covariates at the state level were income inequality and per capita gross domestic product. The results of logistic multilevel modelling showed a number of measures of state-level gender inequity were significantly associated with men's mortality. In all of these cases greater gender inequity was associated with an increased mortality risk. In fully adjusted models for all-age adult men the elected office (OR 1.05 95% CI 1.01–1.09), business ownership (OR 1.04 95% CI 1.01–1.08), earnings (OR 1.04 95% CI 1.01–1.08) and relative poverty (OR 1.07 95% CI 1.03–1.10) measures all showed statistically significant effects for each 1 standard deviation increase in the gender inequity *z*-score. Similar effects were seen for working-age men. In older men (65+ years) only the earnings and relative poverty measures were statistically significant. This study provides evidence that gender inequity may increase men's health risks. The effect sizes while small are large enough across the range of gender inequity identified to have important population health implications.

1. Introduction

Gender inequity continues to be a reality across the globe (Social Watch n.d.; United Nations Development Program (UNDP), 2011; World Economic Forum (WEF), 2014; World Bank, 2011). With few exceptions, men are the beneficiaries of this inequity with advantages that accrue across the political, economic and social realms (Connell, 2002). Given the strong relationship between social position and health (Antonovsky, 1967; Glymour, Avendano, & Kawachi, 2014; Krieger, Williams, & Moss, 1997; Link & Phelan, 1995; Lynch & Kaplan, 2000; Marmot, 2010; Marmot & Wilkinson, 1999) it could be expected that this would translate into men experiencing better health.

However, overall men do not experience better health than women. This is most clearly illustrated by male mortality patterns. Men on average have a 5–7 year lower life expectancy than women (European Commission, 2011; Organisation for Economic Co-operation and Development (OECD), 2011; Wang et al., 2012). With regards to morbidity, the pattern is more complex. There are cases, such as psychological distress and depressive disorders, where men's health appears to be better (Hyde, 2014; Macintyre, Hunt, & Sweeting, 1996; Piccinelli & Wilkinson, 2000; Seedat et al., 2009). However, for many other diseases a pattern of lower morbidity in men is not consistently seen (Macintyre et al., 1996). For example, in the cases of self-rated health and limiting longstanding illness, while there is a tendency for men to report better health, in many cases there is either no sex difference or men's health is worse (Bambra et al., 2009; Dahlin & Härkönen, 2013). Further, when it comes to the most serious illnesses men are often at greater risk (Courtenay, 2003; Courtenay, 2011). For example, within Europe men have a higher overall rate of hospital admission for all of the principal diseases and health problems (European Commission, 2011, p. 153).

Biological factors provide one obvious explanation for this pattern of poor health. Men display a range of differences from women that increase their susceptibility to many diseases (Austad, 2006; Eskes & Haanen, 2007; Seifarth, McGowan, & Milne, 2012). However, these differences, at least on their own, appear to explain only a relatively

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limited part of the gendered health pattern (European Commission, 2011). This is most clearly illustrated by studies of exceptional communities in which male excess mortality relative to women is significantly reduced (Luy & Gast, 2014). For example, men residing in regional Sardinia and German monasteries have displayed life expectancies approaching that of women in similar communities (Luy, 2003; Poulain, Pes, & Salaris, 2011).

As such, the relationship between gender inequity and men's health presents as a paradox. Men receive a range of social, economic and political benefits from the privileged social position accorded them by gender inequity, yet they do not appear to receive commensurate health benefits (Dolan, 2014; Springer & Mouzon, 2011).

A possible explanation for this pattern that is receiving increased attention is that gender inequity itself contributes to men's poor health (Courtenay, 2000a; Holter, 2014; Sen & Östlin, 2008; Stanistreet, Bambra, & Scott-Samuel, 2005; Stillion, 1995). There are a number of plausible theoretical approaches that explain how this could occur. Perhaps the most developed of these is a masculinities and health approach. It argues that the social practices men use in acquiring power over women, and other men, are intertwined with behaviours that are harmful to their health (Courtenay, 2000a; Courtenay, 2000b; Courtenay, 2003; Courtenay, 2011; Evans, Frank, Oliffe, & Gregory, 2011; Pyke, 1996). For example, risk-taking and lack of care for health can be seen as ways that men attempt to demonstrate their superiority to women and maintain their ranking amongst other men (Courtenay, 2000a).

Another relevant approach, role expansion theory, suggests that men who undertake a greater number of social roles, such as household management and childcare, are able to access psychological and social resources that are protective for health (Barnett & Hyde, 2001). For example, men who can draw self-esteem from their involvement in childcare may be less impacted by threats to self-esteem that arise in the workplace environment or from unemployment (Barnett & Hyde, 2001).

A structural pluralist approach also suggests a plausible pathway between gender inequity and the poor health of men (Young, 2001; Young, 2009; Young & Lyson, 2001). It argues that the involvement of diverse segments of a community in political processes related to policy formation is important for health. In particular, the involvement of diverse groups, such as women, in these processes increases the likelihood of communities attaining appropriate medical related investments and also optimizes the biological functioning of the individuals within the community (Young, 2001; Young & Lyson, 2001). This approach, while distinct, has similarities with aspects of social capital theory (Young, 2009).

There has been some empirical work investigating the relationship between gender inequity and men's health. However, a relatively limited number of studies have investigated the influence of gender inequity on men's health when gender inequity is measured at the societal level. Yet, gender inequity inherently involves broad social processes. Importantly, feminist theorists have identified the existence of patriarchal power structures that serve as the basis for the institutionalisation of men's privileged social position (Lerner, 1986; Reeves & Baden, 2000). These processes have been identified in social institutions such as the state, the legislature, religion and legal systems (Connell, 1995; Connell, 2002; Ogle & Batton, 2009).

Studies that have examined this issue at the societal level provide evidence that aspects of gender inequity do increase health risks for men (Backhans, Burström, Ponce de Leon, & Marklund, 2012; Holter, 2014; Hopcroft & Bradley, 2007; Kawachi, Kennedy, Gupta, & Prothrow-Stith, 1999; Medalia & Chang, 2011; Niëns & Lowery, 2009; Preston, 1976; Reeves & Stuckler, 2016; Richardson et al., 2014; Roberts, 2012; Stanistreet et al., 2005; Van de Velde, Huijts, Bracke, & Bambra, 2013; Varkey, Kureshi, & Lesnick, 2010; Young, 2001). However, in some of these cases the evidence for an effect is relatively weak. Further, there are also some studies that are unsupportive (Bogdanovica, McNeill, Murray, & Britton, 2011; Hemström, 1999; Stanistreet, Swami, Pope, Bambra, & Scott-Samuel, 2007).

A limitation of many studies is that they have an ecological study design. The inferential strength of ecological studies is undermined by the existence of the ecological fallacy, which occurs when associations between an exposure and an outcome at the aggregated level are inferred to the level of the individual (Selvin, 1958). Such inferences are not necessarily valid (Robinson, 2009 (1950); Thorndike, 1939).

One statistical tool that overcomes this issue is multilevel modelling (Hox, 2010; Snijders & Bosker, 2012). Multilevel modelling allows for the investigation of the effects of variables measured at the group level as they impact on the health of individuals (Diez Roux, 2009; Subramanian, Jones, Kaddour, & Krieger, 2009; Subramanian, Jones, & Duncan, 2009). These effects have been referred to as ‘contextual effects’ (Diez Roux, 2002). A multilevel approach has only been applied in a few studies that examine the relationship between gender inequity at the broader social level and men's health at the individual level (Hopcroft & Bradley, 2007; Roberts, 2012; Van de Velde et al., 2013). None of these studies has investigated the effects of gender inequity on men's mortality.

This study examines the relationship between gender inequity and men's mortality with a multilevel approach. In particular, it investigates whether state-level measures of gender inequity are predictors of men's mortality in the United States (US). States in the US represent administrative units with distinct legal, political and socioeconomic cultures and policies. As such, they provide a clustering unit that is able to capture a degree of the variance of gender inequity across US society.

Previous studies at the state level in the US provide some evidence that gender inequity increases health risks for men. For example, in an ecological study, Kawachi et al. (1999) found that some state-level measures of women's status were predictors of lower mortality in men, but did not affect days of activity limitation. In a further ecological study, Holter (2014) found that measures of gender equality at the state level were associated with a lower risk of violent death in men. Finally, in a multilevel study, Roberts (2012) found that some measures of state-level gender equality were predictors of lower alcohol consumption and less risky alcohol consumption in men, though for most measures there was no association. The current study aims to build on these findings and contribute to understanding whether gender inequity contributes to men's health risks.

2. Methods

2.1. Study sample

The study was based on data from the National Longitudinal Mortality Study (NLMS) (US Census Bureau, 2013). This US national study is designed to examine the effects of differences in demographic and socioeconomic characteristics on mortality (US Census Bureau, 2013, p. 1). It combines a random sample of the US non-institutionalised population based on US Census Bureau data, including from the Current Population Surveys (CPS), with death certificate information to allow identification of mortality status and the cause of death (US Census Bureau 2013, p. 1). The current study uses File 6b of the NLMS Public Use Microdata Sample, which is an extract of the full NLMS study (US Census Bureau, 2013). The file incorporates data from the CPS in the early 1990s and has a six-year follow-up (US Census Bureau, 2013). Permission to use this data was provided by the US Census Bureau on completion of a user agreement.

2.2. Outcome measure

The outcome measure was dead or alive at the end of a six-year follow-up. This was ascertained from death certificates available through the National Center for Health Statistics (US Census Bureau, 2013, p. 1).

2.3. Gender inequity measures

A range of gender inequity measures was chosen to represent women's social position across important realms. These included the political, the social and economic, and the reproductive realms. Each of these has been identified as making an important contribution to overall gender inequity (Institute for Women's Policy Research, 1996).

Gender inequity was measured with relative measures of men's and women's social positions wherever appropriate. The use of absolute measures of women's social position to infer gender inequity is potentially problematic (Roberts, 2012). For example, two areas with similar levels of educational attainment for women may have very different levels of men's attainment (Roberts, 2012). An exception was made for measures of gender inequity related to reproduction. In cases where measures of inequity deal with sex-specific needs relative measures are not meaningful.

The analysis employed nine state-level measures of gender inequity. Three measures were taken from the Status of Women in the States report produced by the Institute for Women's Policy Research (1996). This report provides state-level measures of women's status across a range of domains. The reproductive rights index is a composite measure constructed from the summing of weighted sub-measures assessing the existence of and/or legal and policy supports for females access to abortion, provision of maternity care, fertility treatments and same-sex adoption. The elected office measure is a composite measure reflecting women's relative office-holding at the state and national levels. The earnings measure reflects the percentage of women's 1989 median yearly earnings relative to men for those who worked more than 49 weeks per year and more than 34 hours per week.

Several gender inequity measures were also developed from US Census Bureau data. These included higher education, a measure of the percentage of males relative to percentage of females 25 years and over with a Bachelor's degree or higher for the year 1990; business ownership, the percentage of male-owned businesses relative to female and equally-owned businesses for 1997; labour force participation, a measure of the percentage of males relative to percentage of females in the labour force for the year 1995; and relative poverty, the percentage of female poverty relative to percentage male poverty for the year 1989. A measure of management, the percentage of males relative to percentage females in executive, administrative and managerial roles was calculated from US Bureau of Labor Statistics data for 1997. Gender inequity was also measured by the state-level percentage of women aged 18–44 living in a county without an abortion provider for the year 1996 (Henshaw, 1998).

All gender inequity measures were standardized to *z*-scores to allow inter-comparability. In all cases the measures were calculated so that increasing value represented increasing inequity.

2.4. Covariates

Individual-level covariates were taken from the NLMS data set and included age in years; income as a percentage of the poverty level adjusted for family size and number of children, measured with 21 categories, but modelled as a continuous variable; education, highest grade completed, measured with 14 categories, but modelled as a continuous variable; race/ethnicity as categorised by white (*reference*), black and other; marital status as categorised by currently in a married relationship (*reference*) or not currently in a married relationship; and employment status as categorised by unemployed (*reference*) or other.

The state-level covariates were income inequality and area-level socioeconomic position. Income inequality was measured by the Gini coefficient. The Gini coefficient is a value between 0 and 1 with 0 representing perfect equality where all entities, such as individuals or households, have equal income and 1 representing perfect inequality where one entity has all income (Atkinson, 1983). The family Gini coefficient for 1993 was taken from the University of Texas Inequality Project (2014). Separate analysis suggested that the family Gini coefficient is highly correlated with the household Gini coefficient (results not shown). State-level socioeconomic position was measured by per capita gross domestic product (GDP). Per capita GDP is a measure of average standard of living or economic well-being (OECD, 2010, p. 20). Data were retrieved from the US Department of Commerce, Bureau of Economic Analysis for the year 1993. An additional measure of state-level socioeconomic position in the form of household median income was also included for sensitivity testing and was taken from the US Census Bureau for the year 1993. These state-level variables were also standardized to *z*-scores to allow inter-comparability with the gender inequity measures.

2.5. Data preparation

The initial data set had 200,702 individuals nested in 50 states. A proportion of these individuals were also nested within households. These cases represented a small proportion of the overall sample and did not warrant a three-level analysis. However, this household clustering undermines the assumption of independence. To deal with this concern additional household cases were deleted so that each case in the data set was taken from a distinct household. Deletion of these additional within household cases led to the loss of 12.3% of cases. A comparison of the data set before and after the removal of these cases suggested little change in the sample. For example, the mean age before removal of these cases was 43.62 years. After removal, the mean age was 43.50 years (calculations not shown).

Cases with missing data were deleted to allow a full-case analysis. The only variable with missing data was the employment status variable with 1239 cases missing. Deletion of these cases led to a loss of less than one per cent of total cases. The final data set included 174,703 individuals nested within 50 states.

2.6. Data analysis

Correlations between state-level measures were estimated with SPSS version 22 (IBM Corp., 2015) using a bivariate Pearson two-tailed analysis. Multilevel logistic regression modelling was undertaken with MLwiN version 2.31 (Rasbash, Steele, Browne, & Goldstein, 2009). A logistic regression approach was used rather than the more usual time to event analysis because the data set had no information on loss to follow-up. Continuous variables were grand-mean centred in modelling.

A second order penalized quasi-likelihood (PQL2) approach was used for model estimation. This approach was chosen due to computational considerations given the large number of models requiring estimation. PQL2 estimation provides the least biased estimates of a number of quasi-likelihood methods and does not entail the large computational requirements of Markov Chain Monte Carlo (MCMC) or Bootstrapping techniques (Goldstein & Rasbash, 1996; Rodriguez & Goldman, 2001; Steele, 2009). However, in some cases, PQL2 estimation may lead to biased results in comparison to these techniques (Rodriguez & Goldman, 2001). To overcome such concerns, sensitivity testing was undertaken with a re-estimation of one of the models with the MCMC estimator to ascertain the accuracy of the PQL2 results (Steele, 2009). The MCMC settings were a burn-in of 5000 and 100,000 iterations.

An initial null model was estimated to ascertain significant state-level variance. Subsequently, each gender inequity measure was modelled in a separate model. The fully adjusted model was:

$$\begin{aligned} Logit(mortality_{ij}) \sim\ & cons + age_{ij} + income_{ij} + education_{ij} \\ & + race/ethnicity\ 2(black)_{ij} + race/ethnicity\ 3(other)_{ij} \\ & + employment\ status\ 2(not\ unemployed)_{ij} \\ & + marital\ status\ 2(not\ married)_{ij} + gini_j + GDP_j \\ & + gender\ inequity\ measure_j \end{aligned}$$

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Table 1
Descriptive statistics.

Measure	Categories	Range (min)	Range (max)	Mean	SD	N	%
Individual Level (n=174703)							
Death	alive (0)					162,677	93.1
	deceased (1)					12,026	6.9
Age (years)		18	90	43.58	17.20		
Income (adj. family relative to poverty)	21 categories	< 50%	> 700%				
Education (highest grade completed)	14 categories						
Race	White					155,489	89
	Black					12,257	7
	Other					6957	4
Employment Status	unemployed					8749	5
	other					165,954	95
Marital Status	Married					114,818	66
	Un-Married					59,885	34
State Level (n=50)							
Higher Education		108.14	157.47	130.07	8.47		
(*z*-score)		-2.59	3.24	0	1		
Reproductive Rights[a]		0.03	5.25	1.89	1.30		
(*z*-score)		-2.57	1.43	0	1		
Provider Access		0.00	84.00	41.86	23.84		
(*z*-score)		-1.76	1.77	0	1		
Elected Office[a]		0.5	4.5	1.73	0.82		
(*z*-score)		-3.31	1.47	0	1		
Management		83.15	149.41	108.86	12.48		
(*z*-score)		-2.06	3.25	0	1		
Business Ownership		84.91	162.24	121.76	22.26		
(*z*-score)		-1.66	1.82	0	1		
Labour Force		116.42	136.93	124.88	5.03		
(*z*-score)		-1.68	2.4	0	1		
Earnings[a]		58.90	76.00	67.56	4.22		
(*z*-score)		-2.00	2.05	0	1		
Relative Poverty		114.29	150.00	129.09	8.19		
(*z*-score)		-1.81	2.55	0	1		
GDP (per capita)		18,616	43,454	26,113	4886		
(*z*-score)		-1.53	3.55	0	1		
Gini		0.36	0.45	0.40	0.02		
(*z*-score)		-1.79	2.04	0	1		

[a] original measures have been multiplied by -1 in *z*-score so that all *z*-scores represent increasing inequity with increasing value

Categorical variables were fitted so that their coefficients represent the log odds ratio with reference to category 1. Separate modelling was performed for each of the following age groups: 18–90+ years, 18–64 years and 65+ years. This age structure was utilised given that health patterns in younger men may be different to those in older men.

An ethics exemption for this study was provided by the Deakin University Human Research Ethics Committee (reference: 2014-152).

3. Results

Table 1 provides descriptive statistics for the final data set. Table 2 provides the correlations between the state-level variables. Unsurprisingly, a large number of gender inequity variables were significantly correlated. These correlations were all positive, with the exception of labour force and relative poverty (r=−0.31). The strongest correlation was between the provider access and reproductive rights measures (r=0.60). The income inequality measure was significantly positively correlated with three of the gender inequity measures. The strongest of these correlations was with the labour force measure (r=0.65). Notably, the income inequality measure was also negatively correlated with the relative poverty measure (r=−0.32) suggesting increasing family income inequality has a weak negative correlation with the extent of inequity in men's and women's poverty. The GDP measure was negatively correlated with the reproductive rights (r=−0.41), provider access (r=−0.64), elected office (r=−0.43) and earnings (r=−0.40) measures. The Gini and GDP were not significantly correlated.

Table 3 provides the odds ratios for the gender inequity variables in each of the logistic multilevel models (see supplementary results for full regression tables). The results were mixed. The majority of the measures showed no statistically significant association. However, four measures did show a statistically significant association. In all cases greater gender inequity was associated with increased mortality risk. In the 18–90+ age group the elected office (OR 1.05 95% CI 1.01–1.09), business ownership (OR 1.04 95% CI 1.01–1.08), earnings (OR 1.04 95% CI 1.01–1.08) and relative poverty (OR 1.07 95% CI 1.03–1.10) measures were all positively associated with mortality risk (see Fig. 1).

Similar associations were seen for the 18–64 age group, though the earnings measure was borderline significant. Only the earnings and relative poverty measures were statistically significant in the 65+ age group. The results of the 65+ model should be treated with some caution. Initial modelling of this age group suggested that state-level residual variance was close to non-significant in a model including only individual level covariates (results not shown). As such, there may have been insufficient variance at the state level to model state-level predictors.

Sensitivity testing comparing PQL2 and MCMC estimation for the elected office measure in the 18–90+ age group showed almost identical results. Sensitivity testing with state-level median household income substituted for GDP in the 18–90+ age group, in general, led to only small changes in the model (see Supplementary results).

Table 2
Correlations between state-level variables.

	Higher edu.	Rep. rights	Provider	Elect. off.	Manage.	Bus. owner.	Lab. force	Earnings	Rel. poverty	Gini	GDP
Higher Education	1	.28[a]	-0.08	-0.01	0.01	0.07	.51[b]	.39[b]	0.02	0.16	-0.16
Reproductive Rights		1	.60[b]	0.25	0.09	-0.14	0.02	.46[b]	-0.17	0.05	-.41[b]
Provider Access			1	.46[b]	0.04	-0.21	-0.11	.49[b]	-0.24	0.04	-.64[b]
Elected Office				1	0.24	.46[b]	0.22	.31[a]	0.04	.42[b]	-.43[b]
Management					1	.45[b]	0.05	0.15	.37[b]	0.06	-0.10
Business Ownership						1	0.27	0.06	.58[b]	.32[a]	0.10
Labour Force							1	.32[a]	-.31[a]	.65[b]	-0.16
Earnings								1	0.01	0.03	-.40[b]
Relative Poverty									1	-.32[a]	0.18
Gini										1	-0.19
GDP											1

Pearson Bivariate (n=50)
[a] Correlation is significant at the 0.05 level (2-tailed).
[b] Correlation is significant at the 0.01 level (2-tailed).

4. Discussion

The results of this study suggest that gender inequity may increase the risk of mortality for men. In the sample analysed, the state-level measures of elected office, business ownership, earnings and relative poverty all showed statistically significant effects in the 18–90+ and 18–64 age group models, although the effect of earnings is only borderline significant in the latter model. The earnings and relative poverty measures were significant in all three of the age groups. However, the results also show that the majority of gender inequity measures had no statistically significant association. As such, it appears that it is only specific aspects of gender inequity that increase men's mortality risk.

The effect sizes are small. However, as the odds ratio is for a one-unit increase in the standardized score, the total increase in risk for the statistically significant measures was substantial. For example, in the 18–64 age group model the absolute risk for the state with the highest level of gender inequity in elected office was 47% greater than for the state with the lowest level. In the case of the relative poverty measure the difference was 43% (results not shown). These risk increases have important population health implications given that gender inequity represents a population-wide exposure.

Of importance is the finding that none of the statistically significant effects of the state-level gender inequity measures predicted lower mortality in men. The implication of this finding is that, at least with regards to mortality, men do not appear get a health benefit from gender inequity. Or, conversely, that men do not suffer a health cost when gender inequity is lower. This finding runs counter to the expected pattern in social epidemiology where higher social position is generally associated with better health.

The finding that gender inequity in earnings was a predictor of higher mortality in men deserves particular consideration given the extensive debates regarding the possible health effects of income inequality (Kondo et al., 2009; Kondo et al., 2012; Lynch et al., 2004; Pickett & Wilkinson, 2015; Wilkinson & Pickett, 2006). One obvious explanation is that gender inequity in earnings is a marker of the same effect. However, in the 18–64 years model the earnings measure and the family Gini measure both showed a statistically significant effect (see Supplementary table 2). The finding that gender inequity in earnings and income inequality independently exert an effect on men's health should be explored further.

A further finding of interest is that the relative poverty measure was a consistent predictor of men's mortality across the three age groups. This indicates that greater levels of women living in poverty relative to men is associated with an increase in men's mortality risks and may suggest the importance of poverty reduction policies for women as indirectly benefitting men.

It is unlikely that the associations for the gender inequity measures were confounded by the effects of socioeconomic position, as the models controlled extensively for socioeconomic factors at both the individual and state levels. However, the possibility of the observed associations being confounded by broader socioeconomic processes cannot be discounted. In particular, gender inequity may indicate processes such as the extent of welfare state formation (Bolzehndahl & Brooks, 2007) or the extent of social integration and support. Examining these pathways was outside of the scope of the analysis.

A further consideration is the effect of religious factors on health. In particular, there are large denominational differences between states in the US (Pew Research Center, 2008). These denominational differences have the potential to confound the relationship between gender inequity and men's health. This could occur because states with high concentrations of conservative religious populations may be less likely to be gender equitable, such as in the case of reproductive rights, and concurrently contain more individuals who follow religious edicts that influence health.

The potential effect of these factors is, however, likely to be to suppress the relationship between gender inequity and men's health. That is, states with higher gender inequity may contain more indivi-

Table 3
Odds ratio (95% C. I.) for mortality for one standard deviation increase in gender inequity *z*-score in fully adjusted multilevel logistic regression.

Gender inequity measure	18–90+ years	18–64 years	65+ years
Higher Education	0.98 (0.95–1.02)	0.99 (0.94–1.04)	0.97 (0.94–1.02)
Reproductive Rights	1.01 (0.97–1.05)	1.03 (0.97–1.08)	1.00 (0.95–1.04)
Provider Access	1.03 (0.98–1.07)	1.05 (0.99–1.11)	1.02 (0.97–1.07)
Elected Office	1.05 (1.01–1.09)[a]	1.08 (1.03–1.14)[a]	1.03 (0.99–1.07)
Management	1.02 (0.99–1.06)	1.02 (0.97–1.06)	1.03 (0.99–1.07)
Business Ownership	1.04 (1.01–1.08)[a]	1.06 (1.01–1.11)[a]	1.03 (0.99–1.07)
Labour Force	0.98 (0.94–1.02)	0.97 (0.91–1.03)	0.98 (0.93–1.03)
Earnings	1.04 (1.01–1.08)[a]	1.05 (1.00–1.10)[a]	1.04 (1.00–1.08)[a]
Relative Poverty	1.07 (1.03–1.10)[a]	1.09 (1.04–1.13)[a]	1.06 (1.02–1.10)[a]

[a] sig. (β/s.e. > 2).

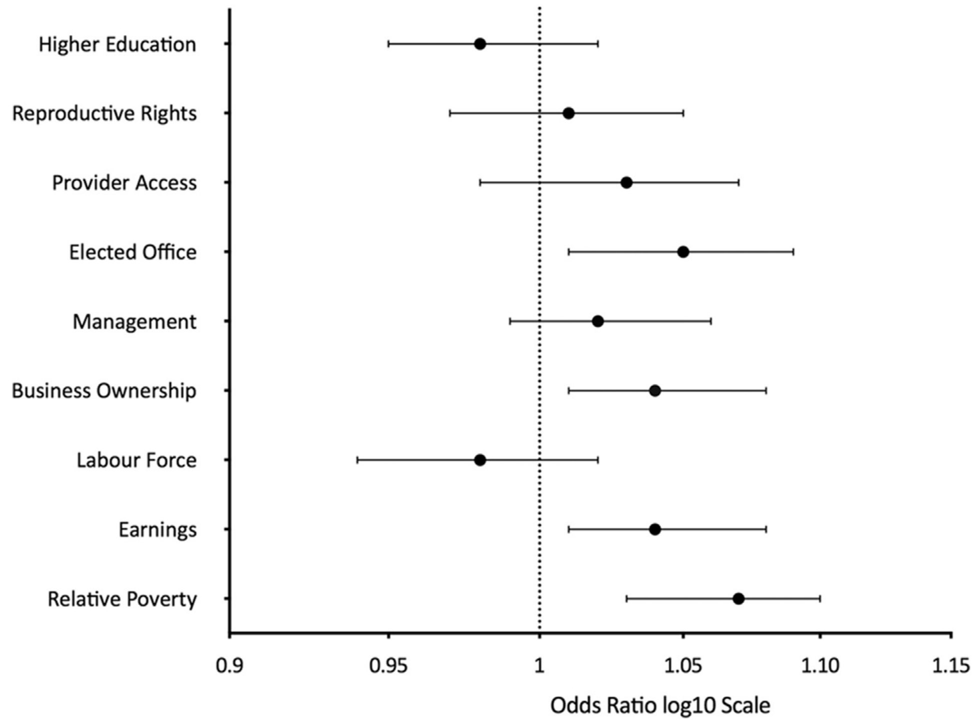

Fig. 1. Plot of odds ratio (95% C. I.) for mortality for one standard deviation increase in gender inequity *z*-score in fully adjusted multilevel logistic regression for 18–90+ yrs.

duals who follow proscriptions against alcohol and tobacco consumption. As such, it is unlikely that religious denominational factors explain the associations seen in the results. Instead, it is likely that they led to an underestimation of the effect of gender inequity.

This study has a number of strengths. First, it utilised a large, good quality data set. Further, the study took a multilevel approach. This allowed for valid inferences about the impact of gender inequity when measured at the societal level on health at the individual level without incurring the ecological fallacy. The study was also strengthened by its use of a wide range of measures of gender inequity, which allowed for identification of a range of manifestations of this social factor.

This study also has important limitations. A major concern is that gender inequity was measured and modelled using only individual measures, rather than combined measures. Such an approach may have missed the additive effects, or interaction effects of multiple aspects of gender inequity occurring concurrently. The follow-up period for mortality was also relatively short at six years. This lag period may not have provided adequate time for the effects of gender inequity to manifest in heightened mortality.

A further limitation of this study is that it utilised all-cause mortality as the outcome measure, rather than cause-specific outcomes. A cause-specific approach would better test the theory that gender inequity is related to health risk-behaviours in men. However, low numbers of cause-specific deaths in the sample at the state level prevented this option.

The findings of this study suggest the value of exploring this topic further. Several aspects deserve particular attention. Investigations should focus on other health outcomes. In particular, attention should be given to causes of mortality or morbidity with the strongest links to theoretical approaches. For example, mortality via trauma is an important outcome to explore given the theorised links between masculinities and risk-taking behaviour.

There is also a need for the measurement and modelling of gender inequity at other levels of social aggregation and in other settings. The international level deserves attention. Countries show marked differences in the extent of gender inequity across a range of different dimensions (Social Watch n.d.; UNDP, 2011; WEF, 2014; World Bank, 2011). Few studies at the country level have utilised a multilevel approach to investigate men's individual level health (Hopcroft & Bradley, 2007; Van de Velde et al., 2013).

Future work should also look at the possible interaction between gender inequity and socioeconomic factors with regard to men's health. A number of authors have suggested that marginalised men may compensate for a subordinate social position by appealing to gender hierarchies through risk-taking behaviour (Courtenay, 2000a; Lohan, 2007; Pyke, 1996). These men may be at the greatest risk from gender inequity.

Finally, there is a need to utilise metrics that combine multiple individual measures of gender inequity. Such an approach has the potential to identify the health impacts of gender inequity when measured as a broad social factor. However, the construction of gender inequity indexes is challenging (Grown, 2008; Permanyer, 2010), and the validity of some measures has been called into question because of methodological uncertainties (see Dijkstra, 2002; Permanyer, 2010).

5. Conclusion

This study provides evidence that gender inequity increases men's mortality risk in the US, although the relationship appears to depend on the specific gender inequity measure modelled. The effect sizes are small, but of sufficient size to be of population health importance.

Understanding men's poor health and high mortality is a challenge for public health. The findings of this study suggest that gender inequity may be an important component in addressing men's health issues. They also suggest that, as well as benefitting women, reducing gender inequity may have significant health benefits for men.

Conflict of interest

The authors have no conflict of interest to declare.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.ssmph.2017.03.003.

References

Antonovsky, A. (1967). Social class, life expectancy and overall mortality. *The Milbank Memorial Fund Quarterly*, 45(2), 31–73.
Atkinson, A. B. (1983). *The economics of inequality* (2nd edn) Oxford: Clarendon Press.
Austad, S. N. (2006). Why women live longer than men: Sex differences in longevity. *Gender Medicine*, 3(2), 79–92.
Backhans, M., Burström, B., Ponce de Leon, A., & Marklund, S. (2012). Is gender policy related to the gender gap in external cause and circulatory disease mortality? A mixed effects model of 22 OECD Countries 1973–2008. *BMC Public Health*, 12(1), 969–980.
Bambra, C., Pope, D., Swami, V., Stanistreet, D., Roskam, A., Kunst, A., & Scott- Samuel, A. (2009). Gender, health inequalities and welfare state regimes: a cross-national study of 13 European countries. *Journal of Epidemiology and Community Health*, 63(1), 38–44.
Barnett, R. C., & Hyde, J. S. (2001). Women, men, work, and family. *American Psychologist*, 56(10), 781–796.
Bogdanovica, I., McNeill, A., Murray, R., & Britton, J. (2011). What factors influence smoking prevalence and smoke free policy enactment across the European union member states. *PLoS ONE*, 6(8), 1–6.
Bolzehndahl, C., & Brooks, C. (2007). Women's political representation and welfare state spending in 12 capitalist democracies. *Social Forces*, 85(4), 1509–1534.
Connell, R. W. (1995). *Masculinities* St Leonards, Australia: Allen Unwin.
Connell, R. W. (2002). *Gender — short introductions* Cambridge, UK: Polity.
Courtenay, W. H. (2000). Constructions of masculinity and their influence on men's well-being: a theory of gender and health. *Social Science Medicine*, 50(10), 1385–1401.
Courtenay, W. H. (2000). Engendering health: a social constructionist examination of men's health beliefs and behaviors. *Psychology of Men Masculinity*, 1(1), 4–15.
Courtenay, W. H. (2003). Key determinants of the health and well-being of men and boys. *International Journal of Men's Health*, 2(1), 1–30.
Courtenay, W. (2011). *Dying to be men: Psychosocial, environmental, and biobehavioral directions in promoting the health of men and boys* 1st edn. Hoboke: Taylor and Francis. Accessed 29.12.14 from Ebook Library.
Dahlin, J., & Härkönen, J. (2013). Cross-national differences in the gender gap in subjective health in Europe: does country-level gender equality matter? *Social Science Medicine*, 98, 24–28.
Diez Roux, A. V. (2002). A glossary for multilevel analysis. *Journal of Epidemiology and Community Health*, 56(8), 588–594.
Diez Roux, A.V., 2009 (2003). The examination of neighborhood effects on health: conceptual and methodological issues related to the presence of multiple levels of organization. In: I Kawachi & LF Berkman (eds), *Neighborhoods and health.* Accessed 19.11.13 from Oxford Scholarship (Online).
Dijkstra, A. G. (2002). Revisiting UNDP's GDI and GEM: towards an alternative. *Social Indicators Research*, 57, 301–338.
Dolan, A. (2014). "Men give in to chips and beer too easily": how working-class men make sense of gender differences in health. *Health*, 18(2), 146–162.
Eskes, T., & Haanen, C. (2007). Why do women live longer than men? *European Journal of Obstetrics Gynecology and Reproductive Biology*, 133(2), 126–133.
European Commission (2011). *The State of Men's Health in Europe*, Directorate-General for Health and Consumers, European Commission. Accessed 04.05.12 from < http://ec.europa.eu/health/population_groups/docs/men_health_extended_en.pdf >
Evans, J., Frank, B., Oliffe, J. L., & Gregory, D. (2011). Health, Illness, Men and Masculinities (HIMM): a theoretical framework for understanding men and their health. *Journal of Men's Health*, 8(1), 7–15.
Glymour, M. M., Avendano, M., & Kawachi, I. (2014). Socioeconomic status and health. , in: Berkman, L. F., Kawachi, I., & Glymour, M. M. (Eds.). (2014). Social epidemiology (http://siteresources.worldbank.org/INTGENDER/Resources/EqualityforWomenfinal.pdf). 2nd edn New York, NY, USA: Open University Press, 17–62.
Goldstein, H., & Rasbash, J. (1996). Improved approximations for multilevel models with binary responses. *Journal of the Royal Statistical Society Series A (Statistics in Society)*, 159(3), 505–513.
Grown, C. (2008). Indicators and indexes of gender equality: what do they measure and what do they miss? , in: Buvinic, M., Morrison, A. R., Ofusu-Amaah, A. W., & Sjöblom, M. (Eds.). (2008). Equality for women: Where do we stand on millenium development goal 3? (http://siteresources.worldbank.org/INTGENDER/Resources/EqualityforWomenfinal.pdf). . The World Bank, 93–145 (< http://siteresources.worldbank.org/INTGENDER/Resources/EqualityforWomenfinal.pdf >).
Hemström, Ö. (1999). Explaining differential rates of mortality decline for Swedish men and women: a time-series analysis, 1945–1992. *Social Science Medicine*, 48(12), 1759–1777.
Henshaw, S. K. (1998). Abortion incidence and services in the United States, 1995–1996. *Family Planning Perspectives*, 30(6) Accessed 22.01.15 from < http://www.guttmacher.org/pubs/journals/3026398.htm > .
Holter, Ø. G. (2014). "What's in it for men?": old question, new data. *Men Masculinities*, 17(5), 515–548.
Hopcroft, R. L., & Bradley, D. B. (2007). The sex difference in depression across 29 countries. *Social Forces*, 85(4), 1483–1507.
Hox, J. (2010). *Multilevel analysis: Techniques and applications* (2nd edn). Taylor and Francis (accessed multiple dates from Ebook Library).
Hyde, J. S. (2014). Gender similarities and differences. *Annual Review of Psychology*, 65(1), 373–398.
IBM Corp (2015). *IBM SPSS software*. Accessed 11.06.15 from < http://www-01.ibm.com/software/analytics/spss/ >
Institute for Women's Policy Research (1996). *Status of Women in the States*, Library of Congress, Washington, DC, USA.
Kawachi, I., Kennedy, B. P., Gupta, V., & Prothrow-Stith, D. (1999). Women's status and the health of women and men: a view from the States. *Social Science Medicine*, 48(1), 21–32.
Kondo, N., van Dam, R. M., Sembajwe, G., Subramanian, S. V., Kawachi, I., & Yamagata, Z. (2012). Income inequality and health: the role of population size, inequality threshold, period effects and lag effects. *Journal of Epidemiology and Community Health*, 66(6), e11.
Kondo, N., Sembajwe, G., Kawachi, I., van Dam, R. M., Subramanian, S. V., & Yamagata, Z. (2009). Income inequality, mortality, and self rated health: meta-analysis of multilevel studies. *BMJ*, 339, b4471.
Krieger, N., Williams, D. R., & Moss, N. E. (1997). Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annual Review of Public Health*, 18(1), 341–378.
Lerner, G. (1986). *The creation of patriarchy*. Oxford University Press (Accessed 07.12.11 from ACLS Humanities E-Book).
Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of Health and Social Behavior*, 80–94.
Lohan, M. (2007). How might we understand men's health better? Integrating explanations from critical studies on men and inequalities in health. *Social Science Medicine*, 65(3), 493–504.
Luy, M. (2003). Causes of male excess mortality: insights from cloistered populations. *Population and Development Review*, 29(4), 647–676.
Luy, M., & Gast, K. (2014). Do women live longer or do men die earlier? Reflections on the causes of sex differences in life expectancy. *Gerontology*, 60(2), 143–153.
Lynch, J., & Kaplan, G. (2000). Socioeconomic position. , in: Berkman, L. F., & Kawachi, I. (Eds.). (2000). Social epidemiology (ebook Accessed 17.08.15 from EBSCO Publishing). . Oxford University Press (ebook Accessed 17.08.15 from EBSCO Publishing).
Lynch, J., Smith, G. D., Harper, S., Hillemeier, M., Ross, N., Kaplan, G. A., & Wolfson, M. (2004). Is income inequality a determinant of population health? Part 1. A systematic review. *Milbank Quarterly*, 82(1), 5–99.
Macintyre, S., Hunt, K., & Sweeting, H. (1996). Gender differences in health: are things really as simple as they seem? *Social Science Medicine*, 42(4), 617–624.
Marmot, M. (2010). *Fair society, healthy lives, the marmot review: Strategic review of health inequalities in England post-2010*. Accessed 20.07.2012 from < http://www.ucl.ac.uk/gheg/marmotreview/Documents/finalreport >
Marmot, M., & Wilkinson, R. (1999). *Social determinants of health* Oxford: Oxford University Press.
Medalia, C., & Chang, V. W. (2011). Gender equality, development, and cross-national sex gaps in life expectancy. *International Journal of Comparative Sociology*, 52(5), 371–389.
Niëns, L., & Lowery, D. (2009). Gendered epidemiology: sexual equality and the prevalence of HIV/AIDS in Sub-Saharan Africa. *Social Science Quarterly*, 90(5), 1134–1144.
Ogle, R. S., & Batton, C. (2009). Revisiting patriarchy: its conceptualization and operationalization in criminology. *Critical Criminology*, 17(3), 159–182.
Organisation for Economic Co-operation and Development (OECD) (2010). 'GDP per capita in National accounts at a glance 2009. Accessed 13.11.14 from < http://dx.doi.org/10.1787/9789264075108-5-en >
Organisation for Economic Co-operation and Development (OECD) (2011). *Health at a Glance 2011: OECD Indicators*. OECD Publishing (Accessed 03.10.12 from < http://dx.doi.org/10.1787/health_glance-2011-en >).
Permanyer, I. (2010). The measurement of multidimensional gender inequality: continuing the debate. *Social Indicators Research*, 95(2), 181–198.
Pew Research Center 2008, *U.S. Religious landscape survey, Religious affiliation: Diverse and dynamic*. Pew Research Center. Accessed 26.11.14 from < http://religions.pewforum.org/pdf/report2-religious-landscape-study-full.pdf > .
Piccinelli, M., & Wilkinson, G. (2000). Gender differences in depression: critical review. *The British Journal of Psychiatry*, 177(6), 486–492.
Pickett, K. E., & Wilkinson, R. G. (2015). Income inequality and health: a causal review.

Social Science Medicine (< http://dx.doi.org/10.1016/j.socscimed.2014.12.031 >).
Poulain, M., Pes, G., & Salaris, L. (2011). A population where men live as long as women: Villagrande Strisaili, Sardinia. *Journal of Aging Research*, 2011, e153756. http://dx.doi.org/10.4061/2011/153756.
Preston, S. H. (1976). *Mortality patterns in national populations* New York: Academic Press.
Pyke, K. D. (1996). Class-based masculinities: The interdependence of gender, class, and interpersonal power. *Gender and Society*, 10(5), 527–549.
Rasbash, J., Steele, F., Browne, W. & Goldstein, H. (2009). *A User's Guide to MLwiN Version 2.10*. Accessed 31.08.12 from < http://www.bristol.ac.uk/cmm/software/mlwin/download/mlwin-userman-09.pdf >
Reeves, H. & Baden, S. (2000). *Gender and development: Concepts and definitions — Report no. 55*, Bridge development-gender. Institute of Development Studies, University of Sussex. Accessed 15.08.13 from < http://www.bridge.ids.ac.uk/reports/re55.pdf >
Reeves, A., & Stuckler, D. (2016). Suicidality, economic shocks, and egalitarian gender norms. *European Sociological Review*, 32(1), 39–53.
Richardson, E. T., Collins, S. E., Kung, T., Jones, J. H., Tram, K. H., Boggiano, V. L., Bekker, L.-G., & Zolopa, A. R. (2014). Gender inequality and HIV transmission: a global analysis. *Journal of the International AIDS Society*, 17(1) (Accessed 13.01.15 from < http://www.jiasociety.org/index.php/jias/article/view/19035 >).
Roberts, S. C. M. (2012). Macro-level gender equality and alcohol consumption: a multi-level analysis across U.S. States. *Social Science Medicine*, 75(1), 60–68.
Robinson, W. S. (2009). Ecological correlations and the behavior of individuals. *International Journal of Epidemiology*, 38(2), 337–341 (1950).
Rodriguez, G., & Goldman, N. (2001). Improved estimation procedures for multilevel models with binary response: a case-study. *Journal of the Royal Statistical Society Series A (Statistics in Society)*, 164(part 2), 339–355.
Seedat, S., Scott, K. M., Angermeyer, M. C., Berglund, P., Bromet, E. J., Brugha, T. S. Kessler, R. C. (2009). Cross-national associations between gender and mental disorders in the World Health Organization World Mental Health Surveys. *Archives of General Psychiatry*, 66(7), 785–795.
Seifarth, J. E., McGowan, C. L., & Milne, K. J. (2012). Sex and life expectancy. *Gender Medicine*, 9(6), 390–401.
Selvin, H. C. (1958). Durkheim's suicide and problems of empirical research. *American Journal of Sociology*, 63(6), 607–619.
Sen, G., & Östlin, P. (2008). Gender inequity in health: why it exists and how we can change it. *Global Public Health*, 3, 1–12.
Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: an introduction to basic and advanced multilevel modeling* (2nd edn) London: Sage Publications.
Social Watch n.d., '*Measuring Inequity: The.2012 gender equity index | social watch*'. Accessed 27.12.15 from < http://www.socialwatch.org/node/14365 > .
Springer, K. W., & Mouzon, D. M. (2011). "Macho Men" and preventive health care: Implications for older men in different social classes. *Journal of Health and Social Behavior*, 52(2), 212–227.
Stanistreet, D., Bambra, C., & Scott-Samuel, A. (2005). Is patriarchy the source of men's higher mortality? *Journal of Epidemiology and Community Health*, 59(10), 873–876.
Stanistreet, D., Swami, V., Pope, D., Bambra, C., & Scott-Samuel, A. (2007). Women's empowerment and violent death among women and men in Europe: An ecological study. *The Journal of Men's Health Gender*, 4(3), 257–265.
Steele, F. (2009). *Learning environment for multilevel methodology and applications: Module 7: Multilevel models for binary responses*, Accessed 31.08.12 from < http://www.cmm.bris.ac.uk/lemma/ >
Stillion, J. M. (1995). Premature death among males: extending the bottom line of men's health. , in: Sabo, D. F., & Gordon, D. (Eds.). (1995). Men's health and illness: Gender power and the body (Accessed 01.09.15 from EBSCOhost eBook Collection). . Sage Publications, 46–67 (Accessed 01.09.15 from EBSCOhost eBook Collection).
Subramanian, S.V., Jones, K, & Duncan, C, 2009 (2003). Multilevel methods for public health research. In I Kawachi & Berkman, L.F., (eds), *Neighborhoods and health*. Accessed 20.08.12 from Oxford Scholarship (Online).
Subramanian, S. V., Jones, K., Kaddour, A., & Krieger, N. (2009). Revisiting Robinson: the perils of individualistic and ecologic fallacy. *International Journal of Epidemiology*, 38(2), 342–360.
Thorndike, E. L. (1939). On the fallacy of imputing the correlations found for groups to the individuals or smaller groups composing them. *The American Journal of Psychology*, 52(1), 122–124.
United Nations Development Program (UNDP) (2011). Human Development Report 2011. Accessed 05.10.12 from < http://hdr.undp.org/en/reports/global/hdr2011/ >
University of Texas Inequality Project (2014). Accessed 28.01.16 from < http://utip.gov.utexas.edu/ >
US Census Bureau (2013). *National Longitudinal Mortality Study Public Use File Reference Manual*. Accessed 24.04.15 from < https://www.census.gov/did/www/nlms/publications/docs/NLMSPublic-useFileReferenceManual.pdf >
Van de Velde, S., Huijts, T., Bracke, P., & Bambra, C. (2013). Macro-level gender equality and depression in men and women in Europe. *Sociology of Health Illness*, 35(5), 682–698.
Varkey, P., Kureshi, S., & Lesnick, T. (2010). Empowerment of women and its association with the health of the community. *Journal of Women's Health*, 19(1), 71–76.
Wang, H., Dwyer-Lindgren, L., Lofgren, K. T., Rajaratnam, J. K., Marcus, J. R., Levin-Rector, A., Levitz, C. E., Lopez, A. D., & Murray, C. J. (2012). Age-specific and sex-specific mortality in 187 countries, 1970–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet*, 380(9859), 2071–2094.
Wilkinson, R. G., & Pickett, K. E. (2006). Income inequality and population health: a review and explanation of the evidence. *Social Science Medicine*, 62(7), 1768–1784.
World Bank (2011). *World Development Report 2012: Gender equality and development*. Accessed 14.04.12 accessed from < http://go.worldbank.org/6R2KGVEXP0 >
World Economic Forum (2014). *Global gender gap report 2014*. Accessed 22.11.14 from < http://www3.weforum.org/docs/GGGR14/GGGR_CompleteReport_2014.pdf >
Young, F. W. (2001). Structural pluralism and life expectancy in less-developed countries: the role of women's status. *Social Indicators Research*, 55(2), 223–240.
Young, F. W. (2009). *The structural ecology of health and community* Ithaca, NY: The Internet-First University Press (Accessed 25.09.14 from Cornell University eCommons).
Young, F. W., & Lyson, T. A. (2001). Structural pluralism and all-cause mortality. *American Journal of Public Health*, 91(1), 136–138.