Social Science & Medicine 252 (2020) 112809

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

# Trust, happiness and mortality: Findings from a prospective US population-based survey

Alexander Miething[a,*], Jan Mewes[b], Giuseppe N. Giordano[c]

[a] Department of Public Health Sciences, Centre for Health Equity Studies, Stockholm University, SE-106 91, Stockholm, Sweden
[b] Department of Sociology, Lund University, SE-221 00, Lund, Sweden
[c] Genetic and Molecular Epidemiology Unit, Lund University Diabetes Centre, Department of Clinical Sciences, Clinical Research Centre, Lund University, Jan Waldenströms gata 35, Skåne University Hospital, Malmö SE-20502, Sweden

ARTICLE INFO

*Keywords:*
Trust
Happiness
All-cause mortality
Cause-specific mortality
Psychosocial pathway
Cox regression
Competing-risk regression
United States

ABSTRACT

There has been an abundance of research discussing the health implications of generalised trust and happiness over the past two decades. Both attitudes have been touted as independent predictors of morbidity and mortality, with strikingly similar trajectories and biological pathways being hypothesised. To date, however, neither trust nor happiness have been considered simultaneously as predictors of mortality. This study, therefore, aims to investigate the effects of generalised trust and happiness on all-cause and cause-specific mortality. The distinction between different causes of death (i.e. cardiovascular vs. cancer-related mortality) allowed us to assess if psychosocial mechanisms could account for associations between generalised trust, happiness and mortality. The study sample was derived from US General Social Survey data from 1978 to 2010 (response rates ranged from 70 to 82 per cent), and combined with death records from the National Death Index. The analytical sample comprised 23,933 individuals with 5382 validated deaths from all-cause mortality by 2014. Analyses were performed with Cox regression models and competing-risk models. In final models, generalised trust, but not happiness, showed robust and independent associations with all-cause mortality. Regarding cause-specific mortality, trust only showed a significant relationship with cardiovascular mortality. The distinct patterns of association between generalised trust and all-cause/cause-specific mortality suggest that their relationship could be being driven by cardiovascular mortality. In turn, this supports the feasibility of psychosocial pathways as possible biological mechanisms from distrust to mortality.

## 1. Introduction

The 'social' domain continues to retain strong focus in public health research across such disciplines as political science, economics, health psychology and social science. Alongside well-known socio-economic health determinants and individual resources, e.g. social support, (Uchino, 2006), there is a growing body of literature supporting the independent health benefits of less tangible factors, such as societal norms, beliefs and perceptions. In this regard, two distinct foci of interest have emerged in recent years: generalised trust, which captures the belief that others, including strangers, can be trusted (Kawachi, 2018), and subjective perceptions of happiness (Chida and Steptoe, 2008).

Despite trust and happiness research having very different theoretical roots, the past two decades have seen an unwitting convergence of these fields, specifically regarding empirical investigations of health outcomes (Chida and Steptoe, 2008; Koivumaa-Honkanen et al., 2000; Lawrence et al., 2015). Reported health benefits may be attributed to the fact that trust and (to a lesser extent) happiness levels seem relatively immune to short-term exogenous shocks and individual experiences, making them almost 'trait-like' in their overall stability during adulthood (Headey et al., 2010; Lucas and Donnellan, 2007; Uslaner, 2002). Such 'stickiness' points to the impressionable years of childhood and early adolescence (Uslaner, 2002), as well as possible genetic determinants of happiness and trust (Lykken and Tellegen, 1996; Sturgis et al., 2010).

Regarding trust and health, it was Kawachi and colleagues who first empirically investigated associations between contextual-level generalised trust and mortality. In their 1997 US state-level study of income inequality, social capital and mortality (Kawachi et al., 1997), found associations between generalised trust and all-cause mortality, malignant neoplasia, cardiovascular disease (CVD) and stroke. They argued that the social fabric of communities could be adversely affected by income inequality, which further negatively influenced health outcomes.

Subsequent US population-based research by Kawachi et al. (1999) further demonstrated that people living in low-trust US states generally had inferior self-rated health – a validated predictor of morbidity and mortality – when compared to those living in regions where trust

* Corresponding author.
*E-mail address:* alexander.miething@su.se (A. Miething).

https://doi.org/10.1016/j.socscimed.2020.112809
Received 4 October 2019; Received in revised form 13 January 2020; Accepted 17 January 2020
Available online 18 January 2020

prevailed more strongly. Grounded in the theory that aggregated trust captures levels of contextual social capital (Putnam, 2000), mechanisms proposed as to how higher trust could lead to better health outcomes included maintaining access to local healthcare amenities, reducing levels of violent crime and "deviant health-related behaviour", and increasing dissemination of positive health messages and behaviours within communities (Kawachi et al., 1999).

Since then, empirical research investigating the relationship between trust and health has been prolific (Abbott and Freeth, 2008; Islam et al., 2006; Murayama et al., 2012), with strong support emerging for the hypothesis that generalised trust at the contextual- ('social capital') *and* individual- (trait) level predicts health outcomes (Giordano et al., 2019). Psychosocial mechanisms have been hypothesised to impact negatively upon an individual's trust *and* health (Giordano and Lindström, 2010; Takahashi et al., 2005), with research linking low trust to perceived high stress levels and subsequent elevated blood cortisol (Kudielka et al., 2004). Chronically high levels of blood cortisol are themselves linked to deleterious health conditions, particularly CVD, diabetes, depression and early death (Boehm and Kubzansky, 2012). Regarding trust, the focus of this study is solely on individual-level measures.

Further are those findings from the field of health psychology that link individual *distrust* - a core concept of hostility-scale constructs employed to detect cynically hostile personality traits - to increased risk of CVD and mortality (Everson et al., 1997). Though there is some evidence to suggest that this relationship is mediated by deleterious health behaviours, such as drinking alcohol and smoking (Everson et al., 1997), other proposed mechanisms include psychological reactivity to interpersonal stressors (psychosocial mechanisms), increased social conflict and a subsequent decrease in social support over the life-course (Baron et al., 2007).

Regarding happiness and health literature, this affective evaluation of an individual's emotional state, together with cognitive judgements of life satisfaction, help comprise the multifaceted construct of subjective wellbeing (Conceição and Bandura, 2008). Historically, happiness studies helped guide economic research and social policy-making; however, the past two decades have seen an increase in research investigating how subjective happiness also influences health and mortality (Chida and Steptoe, 2008; Koivumaa-Honkanen et al., 2000; Lawrence et al., 2015). It is noteworthy that though often used synonymously, happiness and life satisfaction are considered distinct from each other (Tsou and Liu, 2001). Due to data availability, the focus of this study is solely on individual-level perceptions of happiness.

Despite their different disciplinary roots, the trajectories of trust and happiness within health research are strikingly similar. Not just in those results and conclusions offered, but also in proposed biological pathways from 'exposure' to 'outcome'; for example, both trust (Giordano and Lindström, 2010) and happiness research (Borghesi and Vercelli, 2012) highlight the plausibility and relevance of aforementioned psychosocial mechanisms.

When focus from diverse academic fields converges, as is the case here, new perspectives and prospects for cross-fertilisation of ideas can emerge. However, confluence of these two areas has also highlighted apparent shortcomings. For example, studies from the respective disciplines cite both trust *and* happiness as independent predictors of health and mortality (Borghesi and Vercelli, 2012; Diener and Chan, 2011; Kawachi, 2018; Koivumaa-Honkanen et al., 2000). Yet the past decade has also seen empirical evidence surmising that generalised trust *predicts* happiness (Carl and Billari, 2014; Helliwell and Wang, 2010; Kuroki, 2011; Leung et al., 2013), even with repeat-measures data (Poulin and Haase, 2015). However, of the three empirical papers identified that included measures of trust, happiness *and* health (Carl and Billari, 2014; Elgar et al., 2011; Sabatini, 2014), none considered generalised trust and happiness together as covariates within health outcome models. Our study thus seeks to disentangle and isolate the impact of trust and happiness on mortality.

A recent UK cohort study (Liu et al., 2016) called into question previously established associations between happiness and mortality in the US (Lawrence et al., 2015). Specifically, associations between happiness and mortality were attenuated when adjusting for self-rated health (SRH) at baseline. Kubzansky et al. (2016) further argued that modelling SRH in research concerning happiness and health is methodologically problematic, as individual evaluations of SRH could capture perceived happiness whilst also predicting mortality risk. Therefore, we will test associations between happiness, trust and mortality in models unadjusted for SRH.

While health behaviours play an important role in early death, especially death by CVD and neoplasia, psychosocial mechanisms are purported to contribute more to CVD mortality. As psychosocial pathways have been hypothesised as one plausible biological mechanism from low trust/happiness to earlier death via CVD, in this study, we will investigate the two most common causes of mortality, CVD and neoplasia, alongside all-cause mortality.

## 2. Data & methods

Data were drawn from the General Social Survey (GSS) and linked to mortality registry information from the US National Death Index (NDI). The GSS consists of nationally representative cross-sectional samples of the non-institutionalised US adult population aged 18 years and older. Since its launch in 1972, the GSS was conducted annually (pauses in 1979, 1981 and 1992) until 1994. From then onwards, data were collected in even-numbered years only. Response rates ranged from 70 per cent (2000) to 82 per cent (1993). The area-based (multi-stage) probability sample randomly selected one adult per household. Face-to-face interviews were in English, with Spanish added as survey language in 2006. From 1978 to 2010, survey information from GSS was matched with death certificate data from the NDI, with information about deaths until 2014. The combined GSS-NDI dataset includes 43,505 individuals with 12,558 validated cause-specific deaths. We excluded respondents older than age 89 because of unreliable death records. The trust measure was not included in the survey years 1982 and 1985, leading us to exclude those GSS rounds from our analyses. The GSS used a split ballot design that assigned selected measures to randomised subsamples only, the trust measure being one of those (with the exceptions of 1978, 1986, and 1987, when the trust measure was fielded in the whole sample). Therefore, missing trust values can be expected to be random. To minimize the risk that ratings of trust/happiness were influenced by critical illness, we excluded case1s in which survey year and year of death were less than five years apart. The final study sample, with all variables of interest and listwise deletion of missing values, retained 23,933 individuals surveyed between 1978 and 2010. Of those, 5382 were deceased by 2014, according to NDI data.

### 2.1. Measures

#### 2.1.1. All-cause and cause-specific mortality

The NDI contains information about year and specific cause of death. The Ninth Revision of the International Classification of Diseases (ICD-9) was provided until 1999, the Tenth Revision (ICD-10) thereafter. NDI single-level Clinical Classification Software (CCS) enabled the harmonising of ICD-9 and -10 coding, which rendered 198 distinct categories of primary cause of death. We investigated all-cause mortality and the two most frequent causes of death categories, CVD (ICD-10 chapter IX (I00–I99)) and neoplasia (cancer) mortality (ICD-10 chapter II (C00-D49)).

#### 2.1.2. Explanatory variables

Individuals' generalised trust was derived from the question "Generally speaking, would you say that most people can be trusted, or that you cannot be too careful in dealing with other people?". The response options were "can't be too careful", "it depends" and "most people can be trusted", the latter category acting as reference category throughout our analyses. General happiness referred to the question "Taken all together, how would you say things are these days - would you say that you are very happy, pretty happy, or not too happy?". These three categories were maintained throughout the analyses. In line with the study by Lawrence et al. (2015), "very happy" acted as reference category.

#### 2.1.3. Covariates

The following measures were considered potential confounders in the analyses: age (respondent below or above 60 years of age), birth cohort (respondent born 1944 or earlier, 1945–1959, or 1960 and later), gender, marital status (married vs. not married), race (white/other vs. black), education (college education or higher yes/no), and household income (measured in quartiles defined by inflation-adjusted 1986 constant USD, adjusted for household size by utilising the OECD square root equivalence scale). We also included an extra category to account for missing responses on the income measure.

#### 2.1.4. Statistical analysis

Cox-proportional hazard models with years until death as time scale were used to identify hazards of all-cause mortality. We left-truncated the time scale so that study subjects were not observed until aged 18 years. The proportional hazard assumption was tested using Schoenfeld residuals. For models that violated the assumption, stratified estimates were calculated using Stata's "strata" function. For cause-specific mortality, however, we employed competing risk regression, based on the Fine and Gray (1999) proportional subhazard model. Competing-risk models assume that specific causes of death (such as CVD and cancer) preclude other causes of death (Lambert, 2017). The subdistribution hazard derived from the Fine & Gray competing-risks model denotes the crude risk of a specific event (i.e., specific cause of death) in the presence of other competing events (i.e. all other causes of death).

Sample weights ("WTSSALL") were employed in all analyses to correct for sampling errors. All analyses were performed in Stata 15 (StataCorp, 2017).

## 3. Results

Overall, distrust in strangers prevailed in the sample of US respondents surveyed between 1978 and 2010, with on average only 37 per cent of respondents agreeing with the statement "most people can be trusted" during the period 1978 to 2010 (Table 1). In line with Putnam (2000) 'community lost' hypothesis, there was a clear pattern of decrease in trust from an average of 42 per cent of respondents displaying trust in others in the period 1978 to 1988 to a share of 34 per cent in the period 2000 to 2010 ($p < 0.000$). On average, 12 per cent considered themselves "not too happy" at the time of interview. A further 57 per cent answered "pretty happy", whereas 31 per cent were "very happy". Contrary to trust, happiness did not see a substantial decline in the US during the period 1978 to 2010. Happiness only slightly decreased from 33 per cent stating to be "very happy" in 1978–1988 to 30 per cent in 2000–2010 ($p < 0.000$). Both happiness and social trust varied considerably along lines of race, income, education, birth cohort, and age. Generally, males, non-black, wealthier, more educated, married, and older people had a higher tendency to trust strangers *and* to be happier than their black, poorer, lower educated, and younger counterparts.

To investigate whether happiness and trust were associated with all-cause mortality, we first ran an all-cause mortality model which only included those two measures (Table 2, Model 1). Unadjusted for confounding factors, we found an elevated mortality risk among those that reported being 'not too happy' or 'pretty happy' by the time of interview, replicating the results from a previous study using GSS-NDI data (Lawrence et al., 2015). Similarly, Model 1 is in line with a recent study (Giordano et al., 2019) demonstrating a negative association between

**Table 1**
Descriptive overview.

| | Distribution in the sample, in per cent | Mean, generalised trust[a] *(95% CI)* | Mean, happiness[b] *(95% CI)* |
|---|---|---|---|
| Happiness | | | |
| Not too happy | 12.04 | .24 *(.22–.25)* | |
| Pretty happy | 56.72 | .39 *(.38–.40)* | |
| Very happy | 31.24 | .47 *(.46–.48)* | |
| Trust | | | |
| Can't be too careful | 58.04 | | .56 *(.55–.56)* |
| It depends | 4.77 | | .60 *(.59–.62)* |
| Most people can be trusted | 37.19 | | .65 *(.64–.66)* |
| Education | | | |
| (Junior) college or higher | 29.56 | .55 *(.54–.56)* | .63 *(.63–.64)* |
| Less than college | 70.44 | .33 *(.32–.34)* | .58 *(.57–.58)* |
| Household income | | | |
| Poorest quartile | 21.40 | .26 *(.25–.27)* | .50 *(.50–.51)* |
| 2nd quartile | 22.63 | .35 *(.34–.36)* | .58 *(.58–.59)* |
| 3rd quartile | 23.47 | .45 *(.43–.46)* | .62 *(.61–.63)* |
| Richest quartile | 23.57 | .53 *(.52–.55)* | .66 *(.65–.67)* |
| Income: missing | 8.94 | .35 *(.33–.37)* | .61 *(.59–.62)* |
| Race: Black | 12.74 | .17 *(.16–.18)* | .51 *(.50–.52)* |
| Race: white/other | 87.26 | .43 *(.42–.44)* | .61 *(.60–.61)* |
| Under 60 at time of interview | 84.64 | .39 *(.38–.39)* | .59 *(.58–.59)* |
| Over 60 at time of interview | 15.36 | .44 *(.42–.46)* | .63 *(.62–.64)* |
| Female | 55.68 | .37 *(.36–.38)* | .60 *(.59–.60)* |
| Male | 44.32 | .43 *(.42–.43)* | .60 *(.59–.60)* |
| Married | 53.05 | .44 *(.43–.45)* | .67 *(.66–.67)* |
| Not married | 46.95 | .35 *(.34–.46)* | .51 *(.51–.52)* |
| Born 1889–1944 | 30.81 | .46 *(.45–.47)* | .62 *(.61–.63)* |
| Born 1945–1959 | 34.92 | .43 *(.42–.44)* | .59 *(.59–.60)* |
| Born 1960–1992 | 34.27 | .31 *(.30–.32)* | .58 *(.57–.59)* |

[a] Can't be too careful = 0; it depends = 0.5; most people can be trusted = 1.
[b] Not too happy = 0; pretty happy = 0.5; very happy = 1.

**Table 2**
The associations of trust and happiness with mortality (1978–2010, with registered deaths until 2014). Hazard ratios from Cox regression models with 95% confidence intervals (N = 23,933).
Source:US General Social Survey-National Death Index data 1978–2010 with deaths registered until 2014, N = 23,933.

| | All-cause mortality n of deaths = 5382 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | **HR** | **95% CI** | **HR** | **95% CI** | **HR** | **95% CI** | **HR** | **95% CI** |
| **Generalised trust** | | | | | | | | |
| Most people can be trusted | 1 | | 1 | | | | 1 | |
| It depends | 1.04 | (0.90–1.20) | 1.03 | (0.89–1.19) | | | 1.02 | (0.89–1.18) |
| Can't be too careful | 1.19** | (1.12–1.26) | 1.10** | (1.04–1.17) | | | 1.10** | (1.04–1.17) |
| **Happiness** | | | | | | | | |
| Very happy | 1 | | | | 1 | | 1 | |
| Pretty happy | 1.08* | (1.01–1.15) | | | 1.04 | (0.97–1.11) | 1.03 | (0.97–1.10) |
| Not too happy | 1.16** | (1.05–1.27) | | | 1.06 | (0.96–1.17) | 1.05 | (0.95–1.15) |
| **Education** | | | | | | | | |
| Less than college | | | 1 | | 1 | | 1 | |
| College or higher | | | 0.80** | (0.74–0.86) | 0.78** | (0.73–0.85) | 0.80** | (0.74–0.86) |
| **Household income** | | | | | | | | |
| Richest quartile | | | 1 | | 1 | | 1 | |
| 2nd quartile | | | 1.20** | (1.10–1.31) | 1.21** | (1.11–1.32) | 1.20** | (1.10–1.31) |
| 3rd quartile | | | 1.09* | (1.00–1.19) | 1.10* | (1.01–1.20) | 1.09* | (1.00–1.19) |
| Poorest quartile | | | 1.36** | (1.24–1.50) | 1.37** | (1.25–1.51) | 1.36** | (1.23–1.49) |
| Income missing | | | 1.20** | (1.08–1.35) | 1.22** | (1.09–1.36) | 1.20** | (1.07–1.35) |

Notes.HR = Hazard Ratio; CI = Confidence Interval; * = $p < 0.05$; ** = $p < 0.01$.
Cases with less than 5 years between survey year and year of death were excluded.
All models are stratified by sex, race, age (under/over age 60), marital status, and period of birth.

mortality and trust. We then adjusted for socio-economic and demographic background information separately for trust (Model 2) and happiness (Model 3). Model 2 did *not* support the hypothesis that happiness is an independent predictor of all-cause mortality; however, the previously established negative association between trust and mortality remained robust (Model 3), even when considering happiness (Model 4).

To test the hypothesis that psychosocial pathways could link high levels of trust to lower mortality, we investigated *cause-specific* mortality and its associations with trust and happiness. Table 3 presents findings from competing risk models in which we estimated the likelihood of dying from CVD as opposed to from all other causes. Models 7 & 8 point to a significant impact of distrust on CVD mortality; in contrast, happiness does not (Models 5 & 6). Cancer-related deaths, as a group of deaths unrelated to psychological pathways, were also modelled as an outcome of trust and happiness in competing risk models (Table 3, Model 9). This fully adjusted model rules out any associations between trust, happiness and neoplasia mortality.

## 4. Discussion

This US population-based study is the first to investigate whether individual-level generalised trust and happiness independently predicted all-cause mortality. By using *cause-specific* mortality outcomes, we further sought to corroborate the hypothesis that psychosocial mechanisms could provide a feasible pathway from low trust and unhappiness to mortality. Our findings confirmed that individual-level trust maintained independent and robust associations with all-cause and cardiovascular-specific mortality, even after socio-economic and other demographic factors were considered. Results presented here thus mirror previous empirical findings of associations between generalised trust and longevity (Islam et al., 2006; Kawachi et al., 1997; Murayama et al., 2012).

Conversely, associations between happiness and all-cause mortality were fully attenuated once adjusting for confounders. Several mechanisms have been proposed as to why generalised trust may lead to better health and longevity. Some argue that trust mobilises social support and enables greater collective action, providing greater access to those resources needed to cope better with any potential health hazard (Elgar, 2010; Moore and Kawachi, 2017). Others hint at the genetic aetiology of trust (Oskarsson et al., 2012; Wootton et al., 2016), though there are currently no studies that investigate if the genetic underpinnings of distrust/trust are also linked with known disease risk and/or protective gene variants.

That generalised trust is robustly associated with cardiovascular mortality in this study lends further weight to the idea that psychosocial pathways are a plausible biological mechanism from trust to health (Abbott and Freeth, 2008). To clarify further, if individual-level trust reflects social trustworthiness, then lower levels of trust could be indicative of higher social stressors (Giordano and Lindström, 2010; Wilkinson, 1996). From this perspective, generalised trust acts as buffer, reducing the anxiety stemming from the behaviour of others (Abbott and Freeth, 2008). If high trust facilitates collective action (Coleman, 1988), then it is reasonable to assume that low trust hinders this process, creating greater concern during every-day transactions compared to those conducted within a 'high-trust' milieu. It has been argued that exposure to high levels of social stressors could have a deleterious impact on the cardiovascular system. The biological pathways through which this acts is the hypothalamic-pituitary-adrenal (HPA) axis, the overstimulation of which leads to increased levels of blood cortisol (Rosmond and Björntorp, 2000). Prolonged and/or repeatedly high blood cortisol levels released under conditions of perceived stress have been shown to increase one's risk of atherosclerosis (Dekker et al., 2008) and coronary artery calcification over the life-course (Hamer et al., 2012).

In this study, individuals who distrusted others had, in comparison to the trusting group, a 13 per cent elevated risk of death caused by cardiovascular disease (Table 3, Model 7 & 8). However, from the analyses performed, it is not possible to distinguish if individual trust is an interpretation of environmental trustworthiness (hinting at the social capital debate) or whether it captures pathological distrust, an element of the personality trait known as cynical hostility (Kawachi, 2018). Cynically hostile individuals are also reported to have an increased cardiovascular mortality risk, with possible pathways from distrust to cardiovascular mortality including socio-economic status and the same HPA-axis mechanisms previously described (Everson et al., 1997).

### 4.1. Strengths & limitations

This is the first study to independently investigate the effects of both generalised trust and happiness on mortality outcomes, using rich US

**Table 3**
The associations of trust and happiness (1978–2010) with cancer and cardiovascular mortality (from NDI up until 2014). Subhazard ratios (SHR) from competing-risk regression models with 95% confidence intervals (N = 23,933).
Source: US General Social Survey-National Death Index data 1978–2010 with deaths registered until 2014, N = 23,933.

| | Cardiovascular mortality n of deaths = 1857 | | | | | | | | Cancer mortality n of deaths = 1475 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Model 5** | | **Model 6** | | **Model 7** | | **Model 8** | | **Model 9** | |
| | **SHR** | **95% CI** | **SHR** | **95% CI** | **SHR** | **95% CI** | **SHR** | **95% CI** | **SHR** | **95% CI** |
| **Generalised trust** | | | | | | | | | | |
| Most people can be trusted | 1 | | | | 1 | | 1 | | 1 | |
| It depends | 1.09 | (0.85–1.40) | | | 1.06 | (0.83–1.36) | 1.05 | (0.82–1.35) | 0.95 | (0.72–1.26) |
| Can't be too careful | 1.23** | (1.11–1.36) | | | 1.13* | (1.01–1.25) | 1.13* | (1.01–1.25) | 1.06 | (0.94–1.19) |
| **Happiness** | | | | | | | | | | |
| Very happy | 1 | | 1 | | | | 1 | | 1 | |
| Pretty happy | 1.10 | (0.98–1.22) | 1.11 | (0.99–1.24) | | | 1.10 | (0.99–1.23) | 0.93 | (0.83–1.06) |
| Not too happy | 1.01 | (0.85–1.19) | 0.99 | (0.84–1.18) | | | 0.98 | (0.82–1.16) | 1.00 | (0.83–1.22) |
| **Gender** | | | | | | | | | | |
| Male | | | 1 | | 1 | | 1 | | 1 | |
| Female | | | 0.68** | (0.62–0.76) | 0.68** | (0.62–0.76) | 0.68** | (0.62–0.75) | 0.94 | (0.84–1.05) |
| **Race** | | | | | | | | | | |
| White/other | | | 1 | | 1 | | 1 | | 1 | |
| Black | | | 1.34** | (1.15–1.56) | 1.30** | (1.12–1.52) | 1.30** | (1.12–1.52) | 1.09 | (0.92–1.31) |
| **Age** | | | | | | | | | | |
| Under 60 at time of interview | | | 1 | | 1 | | 1 | | 1 | |
| Over 60 at time of interview | | | 1.61** | (1.43–1.82) | 1.60** | (1.42–1.81) | 1.61** | (1.42–1.81) | 1.02 | (0.88–1.18) |
| **Marital status** | | | | | | | | | | |
| Not married | | | 1 | | 1 | | 1 | | 1 | |
| Married | | | 0.98 | (0.88–1.09) | 0.97 | (0.87–1.08) | 0.98 | (0.88–1.09) | 1.04 | (0.92–1.18) |
| **Education** | | | | | | | | | | |
| Less than college | | | 1 | | 1 | | 1 | | 1 | |
| College or higher | | | 0.74** | (0.64–0.85) | 0.76** | (0.66–0.87) | 0.76** | (0.66–0.87) | 0.75** | (0.65–0.87) |
| **Household income** | | | | | | | | | | |
| Richest quartile | | | 1 | | 1 | | 1 | | 1 | |
| 2nd quartile | | | 1.16 | (0.99–1.36) | 1.15 | (0.98–1.34) | 1.15 | (1.10–1.53) | 1.01 | (0.85–1.20) |
| 3rd quartile | | | 1.02 | (0.87–1.19) | 1.01 | (0.86–1.18) | 1.01 | (0.86–1.18) | 1.00 | (0.85–1.17) |
| Poorest quartile | | | 1.33** | (1.13–1.56) | 1.30** | (1.11–1.54) | 1.30** | (1.10–1.53) | 0.97 | (0.80–1.17) |
| Income missing | | | 1.10 | (0.91–1.34) | 1.08 | (0.89–1.32) | 1.09 | (0.89–1.32) | 1.02 | (0.81–1.28) |
| **Period of birth** | | | | | | | | | | |
| Born 1960–1992 | | | 1 | | 1 | | 1 | | 1 | |
| Born 1945–1959 | | | 1.07 | (0.81–1.41) | 1.08 | (0.82–1.42) | 1.08 | (0.82–1.42) | 1.89** | (1.43–2.51) |
| Born 1889–1944 | | | 2.22** | (1.69–2.92) | 2.25** | (1.70–2.96) | 2.25** | (1.71–2.97) | 2.70** | (2.02–3.61) |

Notes:SHR = Subhazard Ratio; CI = Confidence Interval; * = p < 0.05; ** = p < 0.01.
Cases with less than 5 years between survey year and year of death were excluded.

survey data that span over more than three decades. The GSS data were prospectively linked to mortality registries from the NDI, which provided objective and validated specific cause-of-death categories. While these pooled GSS data are nationally representative, this study design relied on single cross-sectional observations, which do not capture change over time. Though a study based on UK panel data showed how individuals' generalised trust could change (Giordano et al., 2012), it tends to re-adapt to a certain 'set point' in the longer term (Dawson, 2017). Considerable stability is also attributed to levels of happiness (Lucas and Donnellan, 2007).

While our study corroborates hypotheses linking generalised trust to longevity, our analysis has consciously ignored important parts of the wider debate on social capital and health. We refrained from analysing additional social capital measures for three important reasons. The first is a simple methodological one: not enough rounds of the GSS contained the desired measures to obtain statistically powerful samples. Secondly, while generalised trust is 'sticky' in adulthood (Uslaner, 2002), other important social capital proxies, e.g. membership in (voluntary) associations and community ties are not. Our data lacked the possibility to track individuals' membership, networks and community social capital longitudinally, making inferences from any estimates untrustworthy. Thirdly, using Canadian survey data, Carpiano and Fitterer (2014) have showed that generalised trust could be conceptually different from other social capital measures.

While survey research generally favours multiple-item scales over single-item measures, our measures of trust and happiness belonged to the latter group. Regarding happiness, the GSS simply lacks additional measures. As for trust, previous research highlighted that the single-item trust measure outperforms the GSS three-item trust scale in terms of reliability and validity (Uslaner, 2015). Moreover, the standard single-item trust measure has, for a long time, featured in a range of international survey studies. Opting for the single-item trust measure thus increases the possibility of replication in future studies in other contexts.

We investigated *cause-specific* mortality in an attempt to substantiate that psychosocial pathways were one plausible biological mechanism from generalised trust to health. Unfortunately, there is no possibility to track health behaviour in the GSS-NDI data after 1994, as questions regarding smoking and drinking were no longer employed. We thus lacked the opportunity to establish associations between trust and CVD mortality adjusting for risky health behaviour. We deliberately focused on deaths caused by either CVD or by neoplasia for two reasons. Firstly, because psychosocial pathways are purported to play a greater role in CVD-related deaths. Secondly, CVD and neoplasia are the two most frequent causes of death in these data. Future studies could investigate other associations between trust and cause-specific deaths, e.g. the infamously theorised association between (a lack of) generalised trust and suicide (Durkheim, 2005). Unfortunately, the GSS-NDI drawn for purposes of this study simply lack the statistical power to consider further categories of cause-specific mortality. Finally, all analyses were conducted at the individual level, which makes it impossible to ascertain whether presented relationships

with mortality are due to trust being an individual or a contextual resource (Giordano et al., 2019).

## 5. Conclusion

There is a clear survival advantage for individuals who trust strangers in this US population-based study. Only those associations between generalised trust and all-cause and CVD mortality were robust, having considered the effects of happiness, ethnicity and socio-economic conditions at baseline. Neither happiness nor trust were associated with cancer mortality.

It is noteworthy that the most tenacious impact of generalised trust is on cardiovascular mortality, this being over and above well-known neo-material conditions that contribute to social gradients in mortality. The results of this study also provide empirical evidence as to the biological feasibility of how trust, via psychosocial mechanisms, could affect mortality (Marmot and Wilkinson, 2001). If generalised trust does buffer against psychosocial adversities then decision makers should be aware of the costs and consequences of implementing policies that potentially erode trust levels.

*Source:* US GSS-NDI 1978–2014, N = 23,933 (own calculations).

## CRediT authorship contribution statement

**Alexander Miething:** Conceptualization, Methodology, Formal analysis, Writing - review & editing. **Jan Mewes:** Conceptualization, Formal analysis, Writing - original draft, Funding acquisition, Project administration. **Giuseppe N. Giordano:** Conceptualization, Writing - original draft, Methodology, Funding acquisition.

## Acknowledgements

This work was funded by Riksbankens Jubileumsfonds: The Swedish Foundation for Humanities and Social Sciences (grant number NHS14–2035:1).

## References

Abbott, S., Freeth, D., 2008. Social capital and health: starting to make sense of the role of generalized trust and reciprocity. J. Health Psychol. 13, 874–883.
Baron, K.G., Smith, T.W., Butner, J., Nealey-Moore, J., Hawkins, M.W., Uchino, B.N., 2007. Hostility, anger, and marital adjustment: concurrent and prospective associations with psychosocial vulnerability. J. Behav. Med. 30, 1–10.
Boehm, J.K., Kubzansky, L.D., 2012. The heart's content: the association between positive psychological well-being and cardiovascular health. Psychol. Bull. 138, 655.
Borghesi, S., Vercelli, A., 2012. Happiness and health: two paradoxes. J. Econ. Surv. 26, 203–233.
Carl, N., Billari, F.C., 2014. Generalized trust and intelligence in the United States. PLoS One 9, e91786.
Carpiano, R.M., Fitterer, L.M., 2014. Questions of trust in health research on social capital: what aspects of personal network social capital do they measure? Soc. Sci. Med. 116, 225–234.
Chida, Y., Steptoe, A., 2008. Positive psychological well-being and mortality: a quantitative review of prospective observational studies. Psychosom. Med. 70, 741–756.
Coleman, J., 1988. Social capital in the creation of human-capital. Am. J. Sociol. 94, S95–S120.
Conceição, P., Bandura, R., 2008. Measuring Subjective Wellbeing: A Summary Review of the Literature. United nations development programme (UNDP) development studies (working paper).
Dawson, C., 2017. How Persistent Is Generalised Trust? *Sociology*. , 0038038517718991.
Dekker, M., Koper, J., Van Aken, M., Pols, H., Hofman, A., De Jong, F., et al., 2008. Salivary cortisol is related to atherosclerosis of carotid arteries. J. Clin. Endocrinol. Metab. 93, 3741–3747.
Diener, E., Chan, M.Y., 2011. Happy people live longer: subjective well-being contributes to health and longevity. Appl. Psychol.: Health and Well-Being 3, 1–43.
Durkheim, E., 2005. Suicide: A Study in Sociology. Routledge.
Elgar, F.J., 2010. Income inequality, trust, and population health in 33 countries. Am. J. Public Health 100, 2311–2315.
Elgar, F.J., Davis, C.G., Wohl, M.J., Trites, S.J., Zelenski, J.M., Martin, M.S., 2011. Social capital, health and life satisfaction in 50 countries. Health Place 17, 1044–1053.
Everson, S.A., Kauhanen, J., Kaplan, G.A., Goldberg, D.E., Julkunen, J., Tuomilehto, J., et al., 1997. Hostility and increased risk of mortality and acute myocardial infarction: the mediating role of behavioral risk factors. Am. J. Epidemiol. 146, 142–152.
Fine, J.P., Gray, R.J., 1999. A proportional hazards model for the subdistribution of a competing risk. J. Am. Stat. Assoc. 94, 496–509.
Giordano, G.N., Lindström, M., 2010. The impact of changes in different aspects of social capital and material conditions on self-rated health over time: a longitudinal cohort study. Soc. Sci. Med. 70, 700–710.
Giordano, G.N., Mewes, J., Miething, A., 2019. Trust and all-cause mortality: a multilevel study of US General Social Survey data (1978–2010). J. Epidemiol. Community Health 73, 50–55.
Giordano, G.N., Björk, J., Lindström, M., 2012. Social capital and self-rated health–a study of temporal (causal) relationships. Soc. Sci. Med. 75, 340–348.
Hamer, M., Endrighi, R., Venuraju, S.M., Lahiri, A., Steptoe, A., 2012. Cortisol responses to mental stress and the progression of coronary artery calcification in healthy men and women. PLoS One 7, e31356.
Headey, B., Muffels, R., Wagner, G.G., 2010. Long-running German panel survey shows that personal and economic choices, not just genes, matter for happiness. Proc. Natl. Acad. Sci. 107, 17922–17926.
Helliwell, J.F., Wang, S., 2010. Trust and Well-Being. National Bureau of Economic Research.
Islam, M., Merlo, J., Kawachi, I., Lindström, M., Gerdtham, U., 2006. Social capital and health: does egalitarianism matter? A literature review. Int. J. Equity Health 5.
Kawachi, I., 2018. Trust and Population Health, vol. 447 The Oxford Handbook of Social and Political Trust.
Kawachi, I., Kennedy, B.P., Glass, R., 1999. Social capital and self-rated health: a contextual analysis. Am. J. Pub. Health 89, 1187–1193.
Kawachi, I., Kennedy, B.P., Lochner, K., ProthrowStith, D., 1997. Social capital, income inequality, and mortality. Am. J. Pub. Health 87, 1491–1498.
Koivumaa-Honkanen, H., Honkanen, R., Viinamäki, H., Heikkilä, K., Kaprio, J., Koskenvuo, M., 2000. Self-reported life satisfaction and 20-year mortality in healthy Finnish adults. Am. J. Epidemiol. 152, 983–991.
Kubzansky, L.D., Kim, E.S., Salinas, J., Huffman, J.C., Kawachi, I., 2016. Happiness, health, and mortality. The Lancet 388, 27.
Kudielka, B., Buske-Kirschbaum, A., Hellhammer, D., Kirschbaum, C., 2004. HPA axis responses to laboratory psychosocial stress in healthy elderly adults, younger adults, and children: impact of age and gender. Psychoneuroendocrinology 29, 83–98.
Kuroki, M., 2011. Does social trust increase individual happiness in Japan? Jpn. Econ. Rev. 62, 444–459.
Lambert, P.C., 2017. The estimation and modeling of cause-specific cumulative incidence functions using time-dependent weights. STATA J. 17, 181–207.
Lawrence, E.M., Rogers, R.G., Wadsworth, T., 2015. Happiness and longevity in the United States. Soc. Sci. Med. 145, 115–119.
Leung, A., Kier, C., Fung, T., Fung, L., Sproule, R., 2013. Searching for happiness: the importance of social capital. The Exploration of Happiness. Springer, pp. 247–267.
Liu, B., Floud, S., Pirie, K., Green, J., Peto, R., Beral, V., et al., 2016. Does happiness itself directly affect mortality? The prospective UK Million Women Study. The Lancet 387, 874–881.
Lucas, R.E., Donnellan, M.B., 2007. How stable is happiness? Using the STARTS model to estimate the stability of life satisfaction. J. Res. Personal. 41, 1091–1098.
Lykken, D., Tellegen, A., 1996. Happiness is a stochastic phenomenon. Psychol. Sci. 7, 186–189.
Marmot, M., Wilkinson, R.G., 2001. Psychosocial and material pathways in the relation between income and health: a response to Lynch et al. BMJ 322, 1233–1236.
Moore, S., Kawachi, I., 2017. Twenty years of social capital and health research: a glossary. J. Epidemiol. Community Health 71, 513–517.
Murayama, H., Fujiwara, Y., Kawachi, I., 2012. Social capital and health: a review of prospective multilevel studies. J. Epidemiol. 22, 179–187.
Oskarsson, S., Dawes, C., Johannesson, M., Magnusson, P.K., 2012. The genetic origins of the relationship between psychological traits and social trust. Twin Res. Hum. Genet. 15, 21–33.
Poulin, M.J., Haase, C.M., 2015. Growing to trust: evidence that trust increases and sustains well-being across the life span. Social Psychological and Personality Science 6, 614–621.
Putnam, R.D., 2000. Bowling Alone: the Collapse and Revival of American Community. Simon & Schuster, New York.
Rosmond, R., Björntorp, P., 2000. The hypothalamic–pituitary–adrenal axis activity as a predictor of cardiovascular disease, type 2 diabetes and stroke. J. Intern. Med. 247, 188–197.
Sabatini, F., 2014. The relationship between happiness and health: evidence from Italy. Soc. Sci. Med. 114, 178–187.
StataCorp, 2017. Stata Statistical Software. StataCorp LP, College Station, TX.
Sturgis, P., Read, S., Hatemi, P.K., Zhu, G., Trull, T., Wright, M.J., et al., 2010. A genetic basis for social trust? Political Behav. 32, 205–230.
Takahashi, T., Ikeda, K., Ishikawa, M., Kitamura, N., Tsukasaki, T., Nakama, D., et al., 2005. Interpersonal trust and social stress-induced cortisol elevation. Neuroreport 16, 197–199.
Tsou, M.-W., Liu, J.-T., 2001. Happiness and domain satisfaction in Taiwan. J. Happiness Stud. 2, 269–288.
Uchino, B.N., 2006. Social support and health: a review of physiological processes potentially underlying links to disease outcomes. J. Behav. Med. 29, 377–387.
Uslaner, E., 2002. The Moral Foundations of Trust. Cambridge University Press, New York, New York.
Uslaner, E.M., 2015. Measuring generalized trust: in defense of the 'standard'question. Handbook of Research Methods on Trust. Edward Elgar Publishing.
Wilkinson, R., 1996. Unhealthy Societies: the Afflictions of Inequality. Routledge, London, England.
Wootton, R.E., Davis, O.S., Mottershaw, A.L., Wang, R.A.H., Haworth, C.M., 2016. Exploring the genetic etiology of trust in adolescents: combined twin and DNA analyses. Twin Res. Hum. Genet. 19, 638–646.