Subjective social status and physical health: The role of negative affect and reappraisal

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ABSTRACT

Rationale: Having low subjective social status is associated with an array of negative health outcomes. However, the mechanisms linking subjective social status to health are not yet clear. One candidate mechanism is negative affect. Researchers have proposed that having low subjective social status may be associated with higher levels of negative affect, and these higher levels of negative affect may be associated with poor health. However, research demonstrating that status-related negative affect is prospectively associated with health in humans is limited.

Objective: We examined whether negative affect prospectively mediates the relationship between subjective social status and physical health. In addition, we tested whether reappraisal – an affect regulation strategy used to downregulate negative affect – moderates the links among subjective social status, negative affect, and physical health.

Method: We used two-wave longitudinal data from the Midlife in the United States (MIDUS) project to conduct a series of regression, mediation, and moderated mediation analyses to examine the relationships among subjective social status, negative affect, reappraisal, and health (i.e., four outcomes, chronic conditions, somatic symptoms, self-reported health and mortality).

Results: Negative affect mediates the relationship between status and change in morbidity ($n = 3289$; i.e., change in number of chronic conditions, somatic symptoms, self-reported health) and mortality ($n = 4953$), such that subjective social status is inversely associated with negative affect, and negative affect is positively associated with poor health. Reappraisal moderates each of these relationships, such that individuals who are low on subjective social status and have high scores on a novel measure of reappraisal experience lower levels of negative affect and better health than individuals who are low on subjective social status but who have low scores on this measure.

Conclusion: These results have important implications for our understanding of subjective social status and how it relates to physical health.

1. Introduction

Being socioeconomically less well-off is associated with disadvantages in many important domains, including physical health (Snyder-Mackler et al., 2020). Across many markers of health including birthweight (Martinson and Reichman, 2016), cardiovascular disease (Steptoe and Marmot, 2002), obesity (Ogden et al., 2018), diabetes (Connolly et al., 2000), blood pressure (Leng et al., 2015), cancer (Ward et al., 2004), and mortality (Lantz et al., 1998), research has consistently shown that low socioeconomic status (SES) individuals suffer from worse health than high SES individuals. Intriguingly, subjective social status often predicts health outcomes above and beyond objective markers of SES (Cundiff and Matthews, 2017; Singh-Manoux et al., 2003, 2005; Zell et al., 2018). In other words, a person's perception of his or her social status relative to others seems to play a crucial role in predicting health that is not captured by objective markers of SES.

Given that subjective social status is associated with poor health, what might account for this relationship? One potential mechanism is negative affect (Operario et al., 2004). Specifically, having lower subjective social status may be positively associated with negative affect, and negative affect may be positively associated with poor health. By affect, we mean states that entail "good-for-me" or "bad-for-me"

discriminations, including stress responses, specific emotions, and mood states (Gross, 2015). In humans, individuals with lower objective SES (e.g., income and education) tend to experience more negative life events (McLeod and Kessler, 1990), such as job loss, and tend to live in more chaotic and unpredictable environments than individuals with higher SES (Evans et al., 2005). Non-human research has shown that occupying a low rank in a social hierarchy means that an animal has less control over resources and a diminished ability to predict and control desired goals (Sapolsky, 2004).

These features of the low status experience have been linked to higher blood pressure and increased levels of stress hormones in the blood (Sapolsky, 2004, 2005), and in humans, negative affect has been linked to poor health via both direct and indirect pathways (DeSteno et al., 2013). Direct pathways describe the fact that high levels of negative affect are biologically taxing and constitute a risk factor for disease, such as cardiovascular disease (DeSteno et al., 2013; Kubzansky and Kawachi, 2000). Indirect pathways describe the fact that experiencing higher levels of negative affect can increase the likelihood that individuals engage in behaviors that lead to poor health, such as smoking tobacco or eating unhealthy foods (DeSteno et al., 2013; O'Leary et al., 2018).

Our working model holds that low subjective social status leads to increased negative affect, which in turn leads to poor health. Other researchers have proposed that negative affect might mediate the relationship between subjective social status and health (Operario et al., 2004), but the extant evidence in support of this relationship in humans is inconclusive, particularly in the case of mortality. Previous studies often either use cross-sectional data (Operario et al., 2004), which limits the causal conclusions that can be drawn; or, they treat negative affect as a confound rather than a mediator (Cheon and Hong, 2016). One aim of the present research is to use longitudinal data to directly assess this potential mediation.

If negative affect in fact plays a role in linking subjective social status to health, one implication is that individual differences in the degree to which individuals effectively down-regulate their negative affective states might moderate this association. One specific form of affect regulation that could play a role in this context is reappraisal (Gross, 2015). Reappraisal involves changing the meaning of the affect-eliciting stimulus to change the affect that is experienced (Gross, 2015). Reappraisal has been shown to be highly effective at reducing negative affect across varied contexts including in-lab experiments as well as in the real world (Finkel et al., 2013; John and Gross, 2004). This suggests the possibility that reappraisal might moderate the pathway from subjective social status to health via negative affect. In other words, if negative affect mediates the relationship between subjective social status and health, individuals low in subjective social status who use reappraisal more often might experience lower levels of negative affect and thereby experience better health than individuals low in subjective social status who use reappraisal less often (see Fig. 1).

To our knowledge, prior studies on the links between subjective social status, negative affect, and health have not examined the moderating role of reappraisal. However, prior research offers converging support for the hypothesized role of reappraisal in this context. With respect to affect regulation in general, compared to some other strategies, such as expressive suppression, use of reappraisal is typically a much more effective means of reducing negative affect and the associated allostatic load and autonomic nervous system arousal that can be harmful for health (Ellis et al., 2019; John and Gross, 2004; Mauss and Gross, 2004). With respect to affect regulation in the context of SES, one prior study showed that more frequent use of reappraisal was associated with lower levels of depression for low, but not high, income individuals (Troy et al., 2017). In addition, the Shift-and-Persist model proposes that one reason why some low SES individuals avoid some of the negative health outcomes associated with having low SES is that these individuals are better able to regulate their emotions (i.e., shift) and are also better able to maintain resilience in the face of difficult circumstances (i.e.,
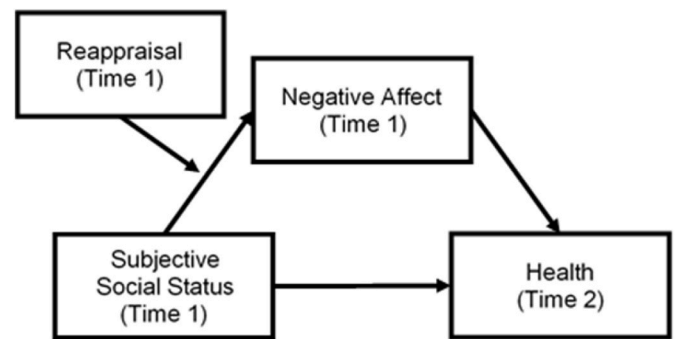

Fig. 1. Hypothesized model. We propose that negative affect mediates the relationship between subjective social status and health. We also propose that this mediation will be moderated by reappraisal such that participants with lower levels of subjective social status who have higher scores on the reappraisal will experience lower levels of negative affect and better health than participants with similar levels of status and lower scores on the MRS.

persist) (Chen and Miller, 2012). However, much of the evidence in support of the shift component of this model comes from studies where the benefits of reappraisal are assessed within a single experimental session, at a single time-point, or at shorter-term follow-up (e.g., 6 months, Chen and Miller, 2012). In the present work, we assess the moderating role played by reappraisal in the context of subjective social status with a focus on longer-term health outcomes assessed over the span of more than a decade.

To assess whether negative affect mediates the link between subjective social status and health, and also whether reappraisal moderates this association, we leveraged a longitudinal dataset from the Midlife in the United States (MIDUS) project. The MIDUS project is a national, longitudinal survey that commenced in 1995. The goal of MIDUS is to assess the psychosocial determinants of health and well-being in the American population. To date, three waves of data have been collected. The first wave was collected over 1995–96, the second wave was collected starting in 2004, and the third wave was collected starting in 2013. In the present research, we used data from the second wave (MIDUS II) of data collection because MIDUS II was the first survey that included a measure of subjective social status: the MacArthur Scale of Subjective Social Status, colloquially known as the MacArthur Ladder (Adler et al., 2000).

The only measure of subjective social status available in the MIDUS dataset is the community version of the MacArthur ladder, which asks participants to indicate where they think they rank within their local community. Most prior work on subjective social status and health has focused on the so-called SES or society version of the MacArthur ladder, which explicitly asks participants where they think they rank in their society in terms of money, education, and occupation (Adler and Stewart, 2007; Cundiff and Matthews, 2017; Operario et al., 2004). Importantly, while researchers find that these two measures are strongly correlated (e.g., 0.53, Zell et al., 2018), recent research suggests that the community version of the measure is somewhat more independent from objective SES than the society version (Zell et al., 2018). In studies that compare the predictive power of the two measures, the magnitude of the relationships between each ladder and health outcomes are quite similar (Zell et al., 2018).

To conduct our analyses, we first derived and validated a novel measure of reappraisal within the MIDUS II dataset: the MIDUS Reappraisal Scale (MRS; see Method and Supplemental Material). Next, we conducted a three-part analysis using waves 2 and 3 of the MIDUS dataset. First, we assessed whether subjective social status directly predicted health (chronic conditions, somatic symptoms, self-reported health, and mortality) at a nine-year follow-up. Next, we assessed whether negative affect mediated any relationship between subjective social status and health. We then used the MRS in the context of a

moderated mediation analysis to assess whether reappraisal moderated these associations. Whereas our mediation analysis tests whether negative affect mediates the relationship between subjective social status and health, our moderated mediation analysis tests whether this pathway exists primarily for people who are either high or low on reappraisal. Across each of these analyses, we predict health at follow-up controlling for health at time 1 to examine the extent to which our variables of interest predict longitudinal change in health. Importantly, while we are able to predict change in health, we only have two waves of data, and our analyses of subjective social status, negative affect, and reappraisal are therefore cross-sectional and unable to tease apart causal ordering. However, the relationships specified in our models have strong theoretical support from prior work (Gross and John, 2003; Troy et al., 2017). In the present work, we examine each of our four measures of health independently and execute the same analytic procedure in parallel across each outcome. In addition, our analyses control for objective SES, race, sex, marital status, and age.

In the Supplemental Material, we conduct a set of analyses using the MIDUS Daily Stress Project, also known as the National Study of Daily Experiences (NSDE), a daily diary sub-study in the MIDUS project that aims to examine the causes and dynamics of stress in daily life. As part of this study, 1841 participants provided daily affect ratings over a period of eight consecutive days. In these analyses, we examine the relationships between subjective social status, reappraisal, and negative affect as measured during the diary study. The results of these analyses closely parallel the findings in the main text.

Importantly, all analyses control for objective SES (i.e., income, education, and occupational prestige) to better illuminate the unique relationships between subjective social status, affect, and health. Controlling for objective SES in the context of subjective social status allows us to examine whether subjective social status predicts unique variance above and beyond objective SES in each of our models. This distinction is of theoretical importance as it relates to ongoing debates regarding whether subjective social status simply reflects a composite of objective SES or whether it reflects distinct factors that relate to health. In the Supplemental Material, we present all analyses from the main text without controlling for objective SES. Results change minimally when excluding these covariates.

We hypothesized that individuals who were low in subjective social status would have higher levels of negative affect and worse health than individuals high in subjective social status. We further hypothesized that negative affect would mediate the relationship between subjective social status and health. Finally, we hypothesized that reappraisal would moderate the links between subjective social status, negative affect, and health such that individuals low in subjective social status, but high on reappraisal would have lower levels of negative affect and better health than individuals who were low in subjective social status and low on reappraisal (see Fig. 1). Importantly, we hypothesized that reappraisal would moderate the path from subjective social status to negative affect and not the path from negative affect to health at time 2 because by definition, reappraisal involves changing the meaning of the affect-eliciting stimulus to change the affect that is experienced. In the present context, reappraisal therefore should moderate how the subjective social status variable is translated into negative affect, but not how experienced negative affect is translated into health. We did not hypothesize that reappraisal would moderate the direct relationship between subjective social status and health at time 2. While the sample size used in the present research is substantial, given the magnitude of the direct relationship between subjective social status and physical health established in prior meta-analyses ($r = 0.05$; Zell et al., 2018), we are not adequately powered to detect a moderation of the direct effect in this context.

2. Methods

2.1. Participants

For all analyses in the main text, we used data from MIDUS II, the first wave of follow-up data collection, and MIDUS III. For MIDUS II, 4953 participants (2640 women, 2313 men, $M_{age} = 55.43$, $SD_{age} = 12.45$) completed the mail-in self-administered questionnaire from 2004 to 2006. For MIDUS III, 3289 (1796 women, 1475 men, 18 not reported, $M_{age} = 63.64$ years, $SD_{age} = 11.35$) participants completed the mail-in self-administered questionnaire from 2013 to 2015. In addition, to validate the MRS, we recruited 300 participants from Amazon's Mechanical Turk platform. Participants were required to have completed at least 100 HITS and also to have an approval rate greater than 95%. In total, 297 participants (189 women, 108 men; *M* age = 36.55 years, SD age = 11.93) provided complete data.

2.2. Procedure

For MIDUS II and III, participants received questionnaires, which they completed and mailed back to researchers. For our validation sample, participants accepted the HIT on mTurk and provided informed consent. Next participants completed a series of surveys. Finally, participants were compensated for their participation.

2.3. Measures

Subjective Social Status. Our measure of subjective social status was the MacArthur Ladder (Operario et al., 2004). The MacArthur Ladder asks participants to choose one of ten rungs on a ladder (10 = highest, 1 = lowest) to indicate their subjective social status. The question text was: "Think of this ladder as representing where people stand in their communities. People define community in different ways; please define it in whatever way is most meaningful to you. At the top of the ladder are the people who have the highest standing in their community. At the bottom are the people who have the lowest standing in their community. Where would you place yourself on this ladder? Please check the box next to the rung on the ladder where you think you stand at this time in your life, relative to other people in the community with which you most identify." This variable was coded as continuous for our analyses.

Negative Affect. Negative affect was assessed using all eleven items in the main MIDUS SAQ that are used to measure negative affect. The question text was: "During the past 30 days, how much of the time did you feel …" Sample items are "upset" or "irritable." Responses ranged from 1 = all of the time to 5 = none of the time. Items were reverse coded and averaged to yield a single measure of negative affect ($\alpha = 0.85$).

Chronic Conditions. Participants were asked, "In the past twelve months, have you experienced or been treated for any of the following …" Conditions ranged from asthma to stroke (please see Supplemental Material for full list of items). Responses were made on a binary (yes/no) response scale. Responses were summed across the 30 items to form an overall measure of chronic conditions.

Somatic Symptoms. Participants were asked, "During the past 30 days, how often have you experienced each of the following …" Symptoms ranged from headaches to trouble sleeping. Responses ranged from 1 = almost every day to 6 = not at all. Responses were reverse-scored and averaged across each of the 10 items to form a summary measure of somatic symptoms.

Self-Reported Health. Participants were asked, "Using a scale from 0 to 10 where 0 means "the worst possible health" and 10 means "the best possible health," how would you rate your health these days?"

Mortality. The Inter-university Consortium for Political and Social Research (ICPSR) provides mortality data for MIDUS. The mortality data included decedent status (deceased or not), month and year of death, and cause of death.

Reappraisal. Our measure of reappraisal was the MRS. Each of the six items that made up the measure were reverse scored (so that higher values indicated higher levels of reappraisal) and averaged (sample item: "When I experience a stressful event, I try to see it in a different light, to make it more positive").

Covariates. We included several measures of objective SES as covariates. These were total income, level of education, and occupational prestige. Income was adjusted according to OECD specifications by dividing total income by the square root of the number of residents in the household and then taking the natural log. Incomes of zero were treated as one; the natural log of one is zero. In addition, we included race, sex, and marital status as covariates.

The measures used to develop the MRS were the Primary and Secondary Control Scale (Heckhausen and Schulz, 2009), the COPE Inventory (Carver et al., 1989), the Spielberger Anger Expression Inventory (Spielberger, 1996), and the Self-Control Scale. Participants in the validation sample completed these measures as well as the Positive and Negative Affect Scale (Watson et al., 1988), the State Trait Anxiety Inventory (Spielberger et al., 1983), and the Emotion Regulation Questionnaire (Gross and John, 2003). Please see the Supplemental Material for additional information regarding these measures.

2.4. Analysis strategy

2.4.1. Preliminary analyses: MRS analyses

To develop the MRS, the first and second authors identified six items in MIDUS II that were independently judged to assess reappraisal. Two items measured reappraisal knowledge, two items measured reappraisal capacity, and two items measured reappraisal use. Four items were from the Primary and Secondary Control Scale (Heckhausen and Schulz, 2009) and two items were from the Cope Inventory (Carver et al., 1989; see Supplemental Material). Next, exploratory factor analyses were conducted using these items. A validation dataset was then collected on Amazon Mechanical Turk. Confirmatory factor analyses were conducted using the validation sample. The reliability of this scale was 0.9 in the sample from Mechanical Turk and the correlation between the reappraisal measure from MIDUS and the reappraisal subscale of the ERQ was 0.70 (p < 0.001) indicating that our reappraisal measure could be used as a validated measure of the construct (see Uysal et al., 2019) for similar procedure). In the MIDUS dataset, the reliability of this measure was $\alpha = 0.84$. We call this measure the MIDUS Reappraisal Scale or the MRS (see Supplemental Material for more detailed information).

2.4.2. Primary analyses: mediation analyses

First, we imputed all data for variables that had fewer than 33% of responses missing using the 'missForest' package in R (see Supplemental Material for additional information on which variables were imputed) (Stekhoven and Buhlmann, 2012). To conduct mediation and moderated mediation analyses, we used the 'mediation' package in R (Tingley et al., 2014). For analyses with morbidity, we tested for the significance of indirect effects using 5000 bootstrapped samples. For mediations that include a survival model, this package tests for the significance of all indirect effects using Quasi-Bayesian Confidence Intervals (Imai et al., 2010) and here we used 5000 samples. For all survival models, time of follow-up was June 1st, 2018, which was the most recent date that the MIDUS mortality dataset was updated. At this point, 719 participants who provided data at MIDUS II (15% of the sample at MIDUS II) were deceased. Following recommendations from experts in epidemiology, instead of using time-on-study as the timescale for our survival models, we use time since birth (Thiébaut and Bénichou, 2004). Importantly, all survival models not used in mediation analyses are Cox Proportional Hazards (CPH) models. The survival models used in the mediation analyses were Accelerated Failure Time (AFT) models as the 'mediation' package in R only works with AFT models at this time. One can transform the coefficients of each type of model to be in the same units as the other. As mentioned above, all survival models controlled for race, sex,

and marital status as covariates. Age was implicitly controlled for as this was used as the timescale for our survival models. All analysis code is available on GitHub (see Supplemental Material).

3. Results

We tested our three hypotheses first with respect to morbidity (analyses parts 1A-1C) and then with respect to mortality (analyses parts 2A-2C).

3.1. Part 1: morbidity

In Part 1 analyses, we hypothesized that lower subjective social status would be associated with increased risk for morbidity and that negative affect would mediate this relationship. We further hypothesized that reappraisal would moderate these effects, such that for individuals low in subjective social status, higher levels of reappraisal would be associated with better health morbidity. In all these analyses, we controlled for objective SES, race, sex, marital status, and age. In addition, we controlled for each measure of morbidity at time 1.

Before conducting our primary analyses, we assessed the strength of association among measures of morbidity. These analyses revealed that the average association among these measures was 0.45, with a maximum association of $r(3287) = 0.54$ (95% CI = [0.52, 0.57], $p < 0.001$) between number of chronic conditions and somatic symptoms. This suggests that these measures indexed separable aspects of health. Please see Table 1 for correlations between other key variables at time 1.

Part 1A: status and morbidity. As predicted, subjective social status negatively predicted number of chronic conditions at time 2, controlling for the same measure at time 1 ($b = -0.03$, 95% CI = [-0.06, -0.01], $t = -2.34$, $p = 0.019$), such that lower subjective social status was associated with greater increases in number of chronic conditions. Subjective social status negatively predicted somatic symptoms at time 2 ($b = -0.05$, 95% CI = [-0.07, -0.02], $t = -3.50$, $p < 0.001$), such that lower subjective social status was associated with greater increases in symptoms. Subjective social status positively predicted self-reported health at time 2 ($b = 0.06$, 95% CI = [0.02, 0.09], $t = 3.50$, $p < 0.001$), such that lower subjective social status was associated with greater declines in self-reported health.

Part 1B: status, morbidity, and affect. Next, we examined whether negative affect mediated the relationships between subjective social status and health identified in Part 1A. As predicted, subjective social status was inversely associated with negative affect ($b = -0.30$, 95% CI = [-0.33, -0.26], $t = -17.35$, $p < 0.001$). As mentioned in the introduction, in Supplemental Material, we present a series of supplemental analyses that showcase consistent relationships between subjective social status and negative affect using diary measures of negative affect from the MIDUS Daily Stress Project.

Consistent with our hypotheses, when testing for a mediation that controlled for health at time 1, negative affect fully mediated the relationship between subjective social status and number of chronic conditions (indirect effect or Average Causal Mediated Effect: ACME = -0.04, 95% CI = [-0.05, -0.02], $p < 0.001$; direct effect or Average Direct Effect, ADE, $p = 0.986$), fully mediated the relationship between subjective social status and somatic symptoms (ACME = -0.02, 95% CI = [-0.03, -0.02], $p < 0.001$; ADE, $p = 0.130$), and fully mediated the relationship between subjective social status and self-reported current health (ACME = 0.03, 95% CI = [0.02, 0.04], $p < 0.001$, ADE, $p = 0.119$).

Part 1C: status, morbidity, affect, and reappraisal. To examine the degree to which reappraisal might moderate the mediations examined in Part 1B, we conducted moderated mediation analyses for each pair of status and health outcomes where we found a significant mediation in Part 1B. As predicted, the association between subjective social status and negative affect was moderated by scores on the MRS ($b = 0.09$, 95% CI = [0.07, 0.12], $t = 6.79$, $p < 0.001$), such that participants

Table 1
Correlations between key measures at time 1 with confidence intervals.

Variable	1	2	3	4	5	6	7
1. Subjective Social Status							
2. Income	.06** [.02, .09]						
3. Education	.20** [.17, .23]	.21** [.18, .25]					
4. Occupational Prestige	.17** [.13, .20]	.19** [.16, .23]	.55** [.53, .57]				
5. Negative Affect	−.34** [−.37, −.31]	−.07** [−.11, −.04]	−.07** [−.11, −.04]	−.10** [−.13, −.06]			
6. Chronic Conditions	−.15** [−.18, −.11]	−.12** [−.16, −.09]	−.12** [−.15, −.09]	−.13** [−.16, −.10]	.39** [.36, .42]		
7. Somatic Symptoms	−.21** [−.25, −.18]	−.10** [−.13, −.07]	−.19** [−.22, −.16]	−.19** [−.22, −.16]	.49** [.46, .51]	.54** [.52, .57]	
8. Self−Reported Health	.24** [.21, .27]	.06** [.03, .10]	.12** [.09, .16]	.12** [.08, .15]	−.39** [−.42, −.36]	−.40** [−.43, −.37]	−.42** [−.44, −.39]

Note. Values in square brackets indicate the 95% confidence interval for each correlation. *$p < 0.05$. **$p < 0.01$.
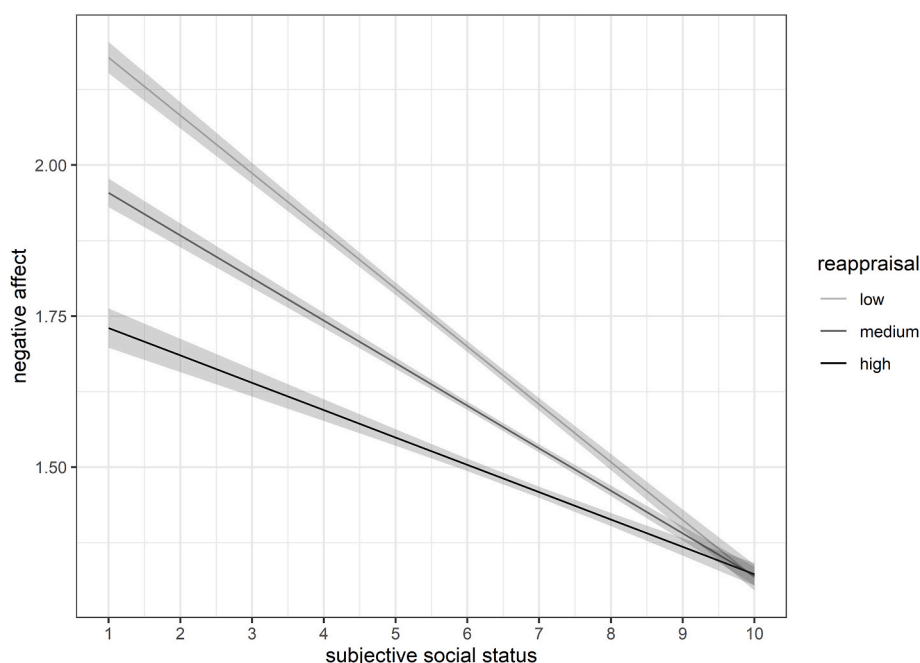
with lower levels of subjective social status and higher scores on the MRS experienced lower levels of negative affect than participants with lower levels of subjective social status and lower scores on the MRS (see Fig. 2). A simple slopes analysis revealed that the inverse relationship between subjective social status and negative affect was stronger for participants with scores that were one SD below the mean on the MRS ($b = −0.31$, 95% CI = [−0.35, −0.26], $t = −14.76$, $p < 0.001$) compared to participants with scores at the mean ($b = −0.21$, 95% CI = [−0.25, −0.18], $t = −12.28$, $p < 0.001$) and one SD above the mean on the MRS ($b = −0.12$, 95% CI = [−0.17, −0.07], $t = −5.17$, $p < 0.001$).

The 'mediation' package in R enables a test of whether two indirect effects (or ACME's) are significantly different from one another. Using this function, we first found that scores on the MRS moderated the mediation of the relationship between subjective social status and number of chronic conditions by negative affect such that this mediation was significantly greater for participants who scored one SD below the mean on the MRS (ACME = −0.04, 95% CI = [-0.05, −0.02], $p < 0.001$; see Fig. 3) than for participants who scored one SD above the mean on the MRS (ACME = −0.01, 95% CI = [-0.02, −0.01], $p < 0.001$; difference in ACME's = −0.02, 95% CI = [-0.04, −0.01], $p = 0.003$; difference in ADE's = 0.01, 95% CI = [-0.06, 0.09], $p = 0.660$).

Next, we found that scores on the MRS moderated the mediation of the relationship between subjective social status and somatic symptoms by negative affect such that this mediation was significantly greater for participants who scored one SD below the mean on the MRS (ACME = −0.03, 95% CI = [-0.04, −0.02], $p < 0.001$; see Fig. 3) than for participants who scored one SD above the mean on the MRS (ACME = −0.01, 95% CI = [-0.01, 0.00], $p = 0.011$; difference in ACME's = −0.02, 95% CI = [-0.032, −0.01], $p = 0.002$; difference in ADE's = 0.01, 95% CI = [-0.05, 0.06], $p = 0.815$).

Finally, we found that scores on the MRS moderated the mediation of the relationship between subjective social status and self-reported health by negative affect such that this mediation was significantly greater for participants who scored one SD below the mean on the MRS (ACME = 0.03, 95% CI = [0.02, 0.05], $p < 0.001$; see Fig. 3) than for participants who scored one SD above the mean on the MRS (ACME = 0.01, 95% CI = [0.00, 0.02], $p = 0.012$; difference in ACME's = 0.02, 95% CI = [0.01, 0.04], $p = 0.002$; difference in ADE's = −0.03, 95% CI = [-0.10, 0.03], $p = 0.308$).

In each of the above cases, reappraisal moderated the effect of subjective social status on negative affect which accounted for differences in health. Specifically, participants with low subjective social status with

Fig. 2. Reappraisal moderates the effect of subjective social status on negative affect. Scores on the MRS moderate the relationship between subjective social status and negative affect (b = 0.09, 95% CI = [0.07, 0.11], t =6.79, p < 0.001) such that participants who have lower levels of subjective social status, but who have higher scores on the MRS, experience lower levels of negative affect than participants who have lower levels of subjective social status and have lower scores on the MRS. Regression controls for objective SES, age, marital status, race, and sex. Low reappraisal is one SD below mean MRS score, medium reappraisal is mean MRS score, high reappraisal is one SD above mean MRS score.
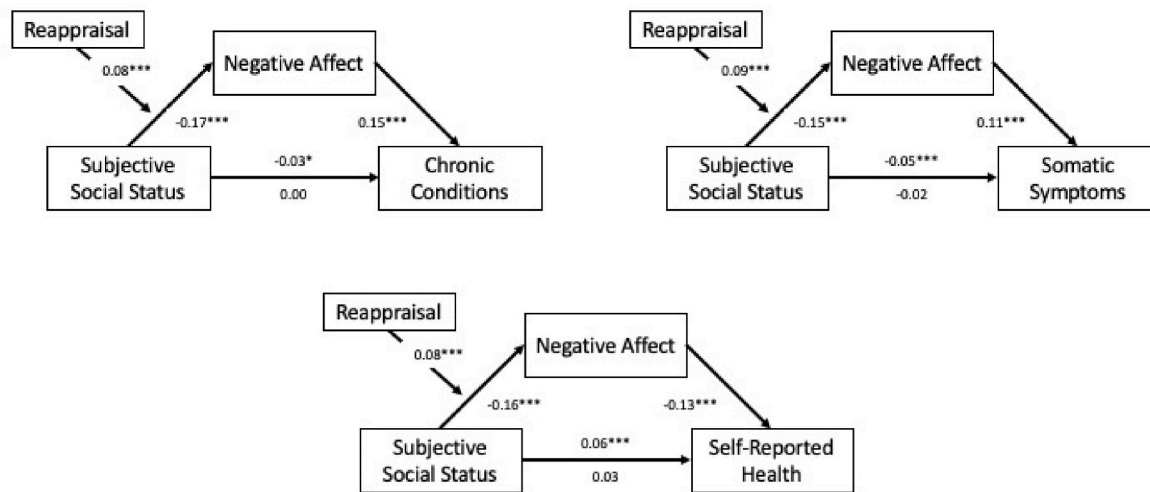
Fig. 3. Results from mediation analyses in Parts 1 B and 1C. All models predict health at time 2, controlling for health at time 1 (not pictured), as well as all other covariates. Note that the coefficient associated with the reappraisal path represents the coefficient for the interaction between reappraisal and subjective social status in predicting negative affect.

higher scores on the MRS experienced lower levels of negative affect and therefore better health than low subjective social status participants with lower scores on the MRS.

3.2. Part 2: mortality

In the next set of analyses, we conducted the same three-part analysis described in sections 1A-1C, but this time with mortality as the outcome. We hypothesized that lower subjective social status would be associated with increased risk for mortality and that negative affect would mediate this relationship. We further hypothesized that reappraisal would moderate these effects, such that for individuals low in subjective social status, higher scores on the MRS would be associated with reduced risk for mortality. In all these analyses, we controlled for objective SES, age, sex, marital status, and race.

Part 2A: Subjective Social Status and Mortality. We first examined the direct effect of subjective social status on mortality. As predicted, in this model, there was a significant direct effect of subjective social status on mortality (HR = 0.91, 95% CI = [0.84, 0.98], $z = -2.48$, $p = 0.013$) such that lower subjective social status was associated with higher risk of mortality (see Table 2, Model 1). Prior research indicates that the relationship between subjective social status and mortality may be moderated by age, such that the inverse relationship is more pronounced among younger participants (Demakakos et al., 2018). We therefore also ran this analysis with the interaction between subjective social status and age included. In this model, the interaction between subjective social status and age was not significant ($p = 0.139$). Model comparison indicated that including the interaction between age and subjective social status did not significantly improve the predictive power of the model, so we left this interactive effect out in Parts 2B and 2C. However, the results in Parts 2B and 2C are unchanged when including this interaction in the model.

Part 2B: Subjective Social Status, Negative Affect, and Mortality. We next examined whether the direct relationship between subjective social status and mortality was mediated by negative affect. As predicted, subjective social status was inversely associated with negative affect ($b = -0.30$, 95% CI = [-0.32, -0.27], $t = -21.52$, $p < 0.001$). Negative affect positively predicted mortality (HR = 1.33, 95% CI = [1.24, 1.42], $z = 8.19$, $p < 0.001$) in a model that included subjective social status (now non-significant, $p = 0.541$; see Table 2, Model 3). Negative affect fully mediated the relationship between subjective social status and mortality (indirect effect or Average Causal Mediated Effect: ACME = 274.15, 95% CI = [204.65, 346.02], $p < 0.001$; direct effect or

Average Direct Effect: ADE = 89.20, 95% CI = [-151.75, 339.65], $p = 0.474$).

Part 2C: Subjective Social Status, Negative Affect, Reappraisal, and Mortality. To examine the degree to which reappraisal constituted a protective factor against the negative health effects of low status on mortality, we conducted a moderated mediation analysis. As predicted, the association between subjective social status and negative affect was moderated by scores on the MRS ($b = 0.08$, 95% CI = [0.06, 0.11], $t = 7.95$, $p < 0.001$), such that participants with lower levels of subjective social status and higher scores on the MRS experienced lower levels of negative affect than participants with lower levels of subjective social status and lower scores on the MRS (see Fig. 2). A simple slopes analysis revealed that the inverse relationship between subjective social status and negative affect was stronger for participants with scores that were one SD below the mean on the MRS ($b = -0.31$, 95% CI = [-0.35, -0.28], $t = -18.68$, $p < 0.001$) compared to participants with scores at the mean ($b = -0.23$, 95% CI = [-0.26, -0.20], $t = -16.41$, $p < 0.001$) and one SD above the mean on the MRS ($b = -0.15$, 95% CI = [-0.18, -0.11], $t = -7.98$, $p < 0.001$).

In a Cox-proportional hazards model, scores on the MRS moderated the relationship between subjective social status and mortality (HR = 1.11, 95% CI = [1.05, 1.18], $z = 3.49$, $p < 0.001$, see Fig. 4), such that participants with lower levels of subjective social status and higher scores on the MRS were at lower risk of death than participants with lower levels of subjective social status and lower scores on the MRS (see Table 2, Model 4). Importantly, the magnitude of this relationship was reduced in strength when negative affect was included in this model (HR = 1.08, 95% CI = [1.01, 1.14], $z = 2.44$, $p = 0.015$; see Table 2, Model 5).

Scores on the MRS moderated the mediation of the relationship between subjective social status and mortality by negative affect. Again using the 'mediation' package (Tingley et al., 2014), we found that the indirect effect of the mediation described in Part 2B was significantly greater for participants whose scored one SD below the mean on the MRS (ACME = 290.09, 95% CI = [214.37, 370.41], $p < 0.001$) compared participants scored one SD above the mean on the MRS (ACME = 134.20, 95% CI = [89.74, 186.60], $p < 0.001$, difference in ACME's 159.68, 95% CI = [68.72, 250.72], $p < 0.001$). In other words, the mediation of the relationship between subjective social status and mortality by negative affect was stronger for participants who had lower scores on the MRS than for participants who had higher scores. The difference in the two direct effects just met criteria for significance (one SD below: ADE = 328.40, 95% CI = [24.03, 627.79], $p = 0.036$; one

Table 2
Results of survival models fit in Parts 2 A-C analyses.

	Model 1	Model 2	Model 3	Model 4	Model 5
	Subjective Social Status	+ Moderation by Age	+ Negative Affect	+ MRS	+ MRS & Negative Affect
Sex: Female	0.68***	0.66***	0.68***	0.67***	0.65***
	[0.59, 0.80]	[0.56, 0.77]	[0.58, 0.79]	[0.57, 0.79]	[0.56, 0.77]
Race: Black and/or African American	1.33	1.22	1.31	1.30	1.28
	[0.93, 1.90]	[0.86, 1.75]	[0.92, 1.87]	[0.91, 1.86]	[0.89, 1.83]
Race: All other categories	1.27	1.21	1.24	1.27	1.25
	[0.92, 1.74]	[0.88, 1.66]	[0.90, 1.71]	[0.92, 1.75]	[0.91, 1.72]
Marital status: Separated	0.61	0.55	0.59	0.62	0.60
	[0.23, 1.63]	[0.20, 1.46]	[0.22, 1.58]	[0.23, 1.67]	[0.22, 1.62]
Marital status: Divorced	1.49***	1.43***	1.44***	1.50***	1.44***
	[1.19, 1.86]	[1.14, 1.80]	[1.15, 1.81]	[1.19, 1.88]	[1.15, 1.81]
Marital status: Widowed	0.99	1.17	0.94	0.99	0.95
	[0.80, 1.22]	[0.95, 1.45]	[0.77, 1.16]	[0.80, 1.22]	[0.77, 1.17]
Marital status: Never married	1.58***	1.55**	1.46**	1.59***	1.50**
	[1.16, 2.14]	[1.14, 2.21]	[1.07, 1.99]	[1.17, 2.17]	[1.10, 2.04]
Income	1.02	1.00	1.04	1.02	1.04
	[0.96, 1.09]	[0.94, 1.06]	[0.97, 1.11]	[0.96, 1.09]	[0.97, 1.11]
Education	0.95	0.93	0.95	0.95	0.95
	[0.87, 1.04]	[0.85, 1.02]	[0.87, 1.04]	[0.87, 1.04]	[0.87, 1.04]
Occupational prestige	0.92	0.90	0.93	0.91	0.93
	[0.81, 1.03]	[0.81, 1.01]	[0.82, 1.05]	[0.81, 1.03]	[0.82, 1.05]
Subjective social status	0.91*	0.87*	0.98	0.92*	0.98
	[0.84, 0.98]	[0.78, 0.98]	[0.91, 1.05]	[0.85, 1.00]	[0.90, 1.05]
Age		3.75***			
		[3.40, 3.13]			
Subjective social status x age		1.07			
		[0.98, 1.16]			
Negative affect			1.33***		1.33***
			[1.24, 1.42]		[1.24, 1.43]
Reappraisal (MRS)				0.99	1.05
				[0.91, 1.07]	[0.97, 1.14]
Subjective social status × MRS				1.11***	1.08*
				[1.05, 1.18]	[1.01, 1.14]

Note. Time since birth was used as the time scale, meaning that age is implicitly accounted for in each model except for the model in which it is included as a predictor. Subjective social status was coded as a continuous variable. Brackets indicate 95% confidence interval.

*p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001.

SD above: ADE, $p = 0.410$; difference in ADE's = 466.99, 95% CI = [10.74, 930.41], $p = 0.044$) indicating that scores on the MRS moderated the direct effect of subjective social status on mortality. Although we predicted that reappraisal would primarily moderate the pathway from subjective social status to negative affect, these results indicate that reappraisal may moderate the influence of unmeasured factors on mortality.

4. Discussion

The present research focused on three primary goals. The first goal was to examine whether subjective social status was prospectively associated with three key markers of health – number of chronic conditions, somatic symptoms, and self-reported current health – and with mortality. The second goal was to examine whether these relationships were mediated by negative affect. The third goal was to examine whether reappraisal moderated the links among subjective social status, negative affect, and health.

Our findings indicated that subjective social status was prospectively associated with each of our three measures of morbidity (see Fig. 3) as well as mortality (see Table 2). Importantly, negative affect mediated each of these relationships. Reappraisal moderated each of these mediations as predicted. Individuals who were low on subjective social status but who had higher scores on the MRS experienced lower levels of negative affect and better health than low subjective social status individuals who had lower scores on the MRS. Importantly, in our analyses with morbidity, we leveraged the longitudinal structure of the data to predict health at time 2 controlling for health at time 1 which enables us

to draw stronger conclusions than would be warranted with cross-sectional data.

These results lend support to the hypothesis that negative affect mediates the relationship between subjective social status and health, a hypothesis that experts in the field have argued needs greater testing (Matthews and Gallo, 2011). We also demonstrated that reappraisal moderated this effect, such that individuals who were low on subjective social status but who had higher scores on the MRS experienced lower levels of negative affect and better health than individuals who had low subjective social status and who also had lower scores on the MRS.

Our primary measure of negative affect in the present research was a retrospective self-report measure of negative affect (i.e., participants reported their levels of negative affect for the preceding 30 days). Retrospective self-report of negative affect is widely used in the affective science literature (Watson et al., 1988) and is considered to be a reliable and valid way of measuring negative affect. However, in Supplemental Material, we repeated a portion of our analyses using daily diary measures of negative affect collected on a subset of the MIDUS II participants after they completed the primary SAQ data collection. These analyses indicate that the measure of negative affect used in the primary analyses is strongly related to these diary measures of negative affect (see Supplemental Material).

Our results add to a growing body of literature on the psychological and physical correlates of having low status (Adler and Rehkopf, 2008; Singh-Manoux et al., 2003, 2005, 2005; Snyder-Mackler et al., 2020; Zell et al., 2018). Whereas many prior studies examining the relationship between subjective social status and health have done so using cross-sectional data or follow-up data collected shortly after the initial
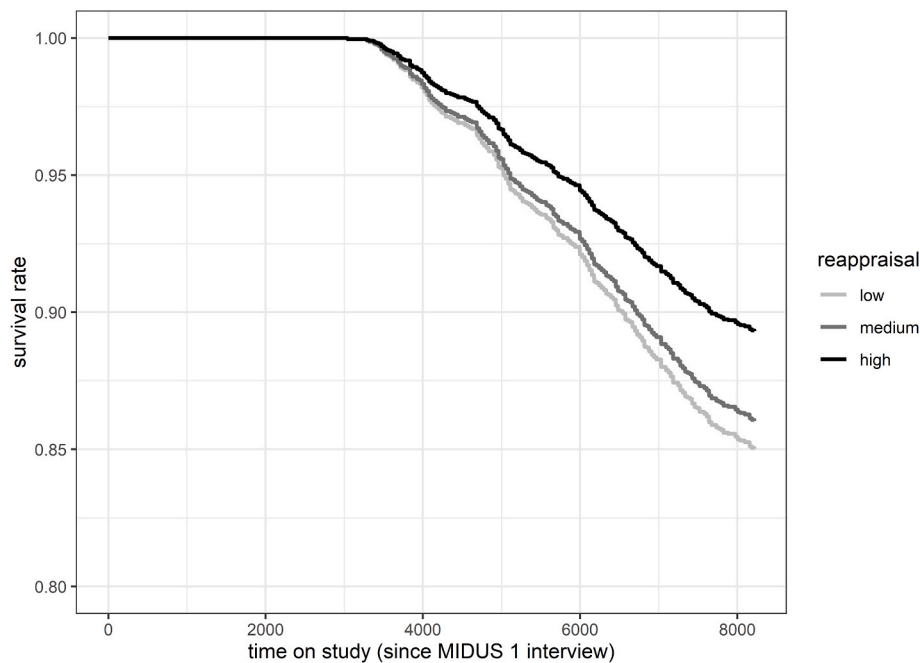
Fig. 4. Survival curves for participants below the median on subjective social status for low, medium, and high levels of reappraisal. Adjusted survival curves for model described in Part 2C Analyses of the results section (using ggadjustcurves () function from 'survminer' package with "marginal" option selected). For purposes of graphical display, timescale used was time on study (rather than time since birth), but statistical results are virtually identical when using time-since birth). Scores on the MRS moderate the effect of subjective social status on mortality (HR = 1.11, 95% CI = [1.05, 1.18], z = 3.49, p < 0.001) such that participants who have lower levels of subjective social status, but who have higher scores on the MRS have lower rates of mortality than participants who have lower levels of subjective social status and have lower scores on the MRS. Regression model controls for objective SES, age, marital status, race, and sex. Low reappraisal is less than one SD below mean MRS score, medium reappraisal is between one SD below and one SD above mean MRS score, high reappraisal is more than one SD above mean MRS score.

assessment, the present research showcased these links over a span of nine years. In addition, the current research is the first to assess the relationships between subjective social status, negative affect, and reappraisal in the context of mortality.

The analyses presented in the main text control for objective SES, indicating that a person's perception of their rank relative to others in their community predicts unique variance in negative affect and health. This finding contributes to an ongoing debate about the relationship between subjective and objective measures of SES. Because subjective measures of social status explicitly assess an individual's rank relative to others, these measures may tap into people's experience with socioeconomic inequality in ways that objective measures do not (Singh-Manoux et al., 2003, 2005). A second perspective is that subjective measures of SES may simply be a more accurate assessment of an individual's personal experience of her own SES (Singh-Manoux et al., 2005). In other words, subjective measures of SES may represent a "cognitive average" of this complex, multi-faceted construct that is difficult to capture with a single objective measure (Singh-Manoux et al., 2005). The fact that subjective social status predicted unique variance in our models after controlling for three separate measures of objective SES lends support to the former hypothesis regarding relative rank.

4.1. Limitations and future directions

In addition to making several important contributions, we note several study limitations as well as directions for future research. First, the data used in the present analyses, though longitudinal, are observational data. In addition, although these data are longitudinal with respect to predicting changes in health, our measures of subjective social status and negative affect were collected at the same time point. Due to the cross-sectional nature of these data, we are unable to tease apart the causal ordering of variables collected at time 1. However, prior research in a laboratory context has shown that reappraisal may be a particularly effective tool for reducing negative affect in participants with low compared to high subjective social status, providing causal support for the cross-sectional pathways hypothesized in the present research (Troy et al., 2013, 2017). As mentioned above, one contribution of the present research is that we examine these same processes as they relate to long-term health, an outcome that it has not typically been possible to examine in prior laboratory research. In addition, our supplemental

analyses leverage a measure of negative affect collected on a subset of participants after they completed the measures used in the primary analyses. Nonetheless, given the importance of these topics to public health, future research should, if possible, continue to examine these relationships using experimentation or other methods for causal inference.

Second, the measure of subjective social status used in the current research – the community version of the MacArthur Scale of Subjective Social Status – differs from the measure most commonly used in prior research: the society version. However, the fact that most prior research implements the society version of the measure is in some ways a strength of this work in that it provides novel insights surrounding this more localized conception of status. Moreover, prior work indicates that the magnitude of the relationship between subjective social status and health is largely the same across the two versions (Zell et al., 2018). Nonetheless, future research on social status and health should incorporate both measures. As mentioned in the introduction, measures of subjective social status are thought to potentially measure a person's experience of socioeconomic inequality (Singh-Manoux et al., 2003, 2005). However, future studies should explicitly measure people's experience of economic inequality to more directly examine this question (Schmalor, 2018).

Third, the present findings indicate that high levels of negative affect may contribute to poor health, but they do not shed light on the precise pathways by which negative affect has this effect. Prior research suggests that negative affect may both directly (e.g. via the biological effects of negative affect on the body) and indirectly (e.g. through unhealthy behaviors) impact health (DeSteno et al., 2013). In the former case, high levels of negative affect and allostatic load may cause biological wear and tear due to chronically high levels of sympathetic nervous system activation (DeSteno et al., 2013). In the latter, people may engage in unhealthy behaviors to make themselves feel better when they feel bad (DeSteno et al., 2013). Future research should more closely investigate the specific pathways by which negative affect leads to poor health with an eye to whether reappraisal is more or less efficacious in reducing the operation of one or the other pathway.

5. Conclusion

Many studies have shown that individuals with lower levels of

subjective social status experience worse health relative to individuals with higher levels of subjective social status. The current study indicates that negative affect mediates this relationship between subjective social status and health, such that subjective social status is inversely associated with negative affect, and negative affect is positively associated with poor health. Furthermore, reappraisal may provide some protection against the negative impacts of having low subjective social status by helping to reduce levels of negative affect. Importantly, the data used in the present research was observational. Future researchers should continue to investigate these relationships using experimental methods as well as alternate methods for causal inference. We therefore hope that these findings inspire future work on this important research topic.

Author credit statement

Daniel O'Leary - Conceptualization; Formal analysis; Methodology; Roles/Writing - original draft; Writing - review & editing. Ahmet Uuysal - Conceptualization; Formal analysis; Methodology, David H. Rehkopf - Conceptualization; Methodology; Writing - review & editing, James J. Gross - Conceptualization; Methodology; Writing - review & editing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2021.114272.

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