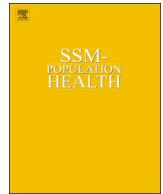




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## Article

## Relative wealth, subjective social status, and their associations with depression: Cross-sectional, population-based study in rural Uganda

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## ABSTRACT

Depression is a leading cause of disability worldwide, and has been found to be a consistent correlate of socioeconomic status (SES). The relative deprivation hypothesis proposes that one mechanism linking SES to health involves social comparisons, suggesting that relative SES rather than absolute SES is of primary importance in determining health status. Using data from a whole-population sample of 1,620 participants residing in rural southwestern Uganda, we estimated the independent associations between objective and subjective relative wealth and probable depression, as measured by the depression subscale of the Hopkins Symptom Checklist (HSCLD). Objective relative wealth was measured by an asset index based on information about housing characteristics and household possessions, which was used to rank study participants into quintiles (within each village) of relative household asset wealth. Subjective relative wealth was measured by a single question asking participants to rate their wealth, on a 5-point Likert scale, relative to others in their village. Within the population, 460 study participants (28.4%) screened positive for probable depression. Using Poisson regression with cluster-robust error variance, we found that subjective relative wealth was associated with probable depression, adjusting for objective relative wealth and other covariates (adjusted relative risk [aRR] comparing lowest vs. highest level of subjective relative wealth = 1.90, 95% confidence interval [CI]: 1.18, 3.06). Objective relative wealth was not associated with probable depression (aRR comparing lowest vs. highest quintile of objective relative wealth = 1.09, 95% CI: 0.77, 1.55). These results suggest that, in this context, subjective relative wealth is a stronger correlate of mental health status compared with objective relative wealth. Our findings are potentially consistent with the relative deprivation hypothesis, but more research is needed to explain how relative differences in wealth are (accurately or inaccurately) perceived and to elucidate the implications of these perceptions for health outcomes.

## Introduction

Depression is a leading cause of disability worldwide (Vos et al., 2017), including in Uganda (Bolton, Wilk, & Ndongoni, 2004), where a population-based survey in a rural area found that one-fifth met criteria for depression according to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) (Bolton et al., 2004). In numerous studies, socioeconomic status (SES) has been found to be a consistent correlate of

depression, psychological distress, and other measures of mental health (Hamad, Fernald, Karlan, & Zinman, 2008; Hanandita & Tampubolon, 2014; Iemmi et al., 2016; Lund et al., 2010, 2011; Muntaner, Eaton, Miech, & O'Campo, 2004). Yet, the mechanisms through which SES affects health remain incompletely explicated. The relative deprivation hypothesis proposes that SES affects health through a process of social comparisons and that socioeconomic position relative to others (e.g., relative income) is more predictive of poor health outcomes than

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absolute income (Marmot & Wilkinson, 2001; Wilkinson, 1996, 1997; Wilkinson & Pickett, 2007). Some studies have found the opposite, however (Jones & Wildman, 2008).

Tests of the relative deprivation hypothesis have primarily been derived from estimates of the association between area-level inequality (e.g. Gini coefficient) and individual-level health (e.g., depression, self-rated health) (Chiavegatto Filho et al., 2013; Cifuentes et al., 2008; Hanandita & Tampubolon, 2014; Patel et al., 2018). However, individual-level measures of relative deprivation may be more suitable than area-level measures for testing the relative deprivation hypothesis, because two individuals living within the same community may have different socioeconomic positions relative to each other. Studies of mortality (Salti, 2010) and self-rated health (Kondo, Kawachi, Subramanian, Takeda, & Yamagata, 2008) based on individual-level measures have supported the relative deprivation/social comparisons hypothesis. The strongest associations between relative deprivation and various physical health measures have been observed among men (Jaffe, Eisenbach, Neumark, & Manor, 2005; Kondo et al., 2015; Yngwe, Fritzell, Lundberg, Diderichsen, & Burström, 2003). Lower relative SES is also associated with worse mental health outcomes, but few studies have focused on depression specifically, especially in low and middle income countries (Hamad et al., 2008; Scott et al., 2014). Most research in this area has focused on psychological distress in general (Franzini & Fernandez-Esquer, 2006) or has been based on data from high-income countries (Adler, Epel, Castellazzo, & Ickovics, 2000; Demakakos, Nazroo, Breeze, & Marmot, 2008; Hoebel, Maske, Zeeb, & Lampert, 2017; Singh-Manoux, Adler, & Marmot, 2003).

A key point of distinction among measures of relative SES is whether they are based on objective or subjective information. *Objective* measures of relative SES may be based on actual relative differences in income, education level, occupational status, or household asset wealth (Filmer & Pritchett, 2001). *Subjective* measures of relative SES, in contrast, may be based on perceived differences in wealth or subjective social status (Collins & Goldman, 2008; Demakakos et al., 2008; Singh-Manoux, Marmot, & Adler, 2005). Subjective social status refers to a person's perceived standing within a social hierarchy and reflects their belief about the extent to which they have equal opportunities compared to those around them (Demakakos et al., 2008; Singh-Manoux et al., 2003). Objective and subjective relative SES are separate constructs that have the potential to affect mental health in different ways (Cundiff & Matthews, 2017). On the one hand, people with objectively fewer resources relative to their peers may be less able to provide for basic needs including food, housing, and physical and mental health care (Hadley et al., 2008). On the other hand, people who perceive themselves to have fewer resources than their peers may experience psychological effects like frustration, stress, and feelings of inferiority (Kondo et al., 2008; Yngwe et al., 2003). Thus, both objective and subjective relative wealth may have independent associations with mental health status.

Previous work has linked depression and mental health status to various absolute measures of SES such as income, education, and occupation (Hamad et al., 2008; Hoebel et al., 2017; Lorant et al., 2003; Lund et al., 2010), as well as to relative income (Osafa Hounkpatin, Wood, Brown, & Dunn, 2015). These study designs, however, do not yield information about the relative deprivation hypothesis. Depression has also been linked to subjective social status (Hamad et al., 2008), even after adjusting for education, income, and/or occupation (Franzini & Fernandez-Esquer, 2006; Scott et al., 2014; Singh-Manoux et al., 2003; Zell, Strickhouser, & Krizan, 2018). Compared with absolute measures of SES, subjective social status has been found to better correlate with depression (Hamad et al., 2008) and other health outcomes (Ahlborg, Svedberg, Nyholm, Morgan, & Nygren, 2017; Demakakos, Biddulph, de Oliveira, Tsakos, & Marmot, 2018; Euteneuer, 2014; Singh-Manoux et al., 2005). Some studies have additionally found that subjective social status mediates the relationship between SES and depression (Demakakos et al., 2008; Hoebel et al., 2017), but they have

relied principally on cross-sectional data.

No studies have directly compared the associations between mental health and objective vs. subjective relative wealth. Tests of the relative deprivation hypothesis would be strengthened by comparing the associations of objective and subjective relative wealth with mental health in a single study. It is also important to adjust for possible confounding of each measure's association with mental health by the other measure. To address these gaps, using data from a whole-population sample of residents from rural southwestern Uganda, we estimated the associations between objective vs. subjective relative wealth and probable depression. Motivated by the work of Wilkinson (1996), we tested three hypotheses:

**H1.** People who have lower levels of objective wealth relative to others have greater risk of depression compared with people who have higher levels of objective relative wealth.

**H2.** People who perceive themselves as having less wealth relative to others have greater risk of depression compared with people who perceive themselves as having greater relative wealth.

**H3.** Subjective measures of relative wealth have a stronger association with depression compared with objective measures of relative wealth.

## Methods

### Sample

The study was conducted in Mbarara District, a rural area of southwestern Uganda approximately 260 km southwest of Kampala. Participants were recruited from the rural administrative subunit of Nyakabare Parish, comprised of eight villages located approximately 20 km outside of Mbarara District's commercial center, Mbarara Town. The primary sources of income and/or livelihood among Nyakabare residents are subsistence farming, animal husbandry, and supplemental migratory work. Food and water insecurity are common in this context (Perkins et al., 2018; Tsai et al., 2012, 2016).

All adults aged 18 years and older and emancipated minors aged 16–17 years currently residing in Nyakabare were enumerated for the study. Stable residence within the parish was required for inclusion. Residents were excluded if they were unable to provide informed consent or were unable to communicate meaningfully with research staff due to psychosis, acute intoxication, neurological damage, deafness, or other reasons, as determined by supervised non-clinical research staff in the field. Of 1,813 eligible participants, 1,776 (98%) from 776 households agreed to take part in the study. Of these, participants with complete data for all variables of interest were included in the present analysis ( $n = 1,620/1,776, 91\%$ ).

Research assistants fluent in the local language (Runyankole) interviewed consenting participants between June 3, 2014, and August 14, 2015. Potential participants were contacted to assess their interest in the study, and written informed consent was obtained before all study procedures. The informed consent document was reviewed verbally with potential study participants, who were probed for comprehension and given opportunities to ask questions. Potential study participants who could not read and/or write were permitted to indicate consent with a thumbprint. Consistent with local etiquette, we provided a study incentive for participation in the form of a kilo of sugar, bar of soap, sack of rice, or something of similar value.

### Measures

**Probable depression:** Participants reported depressive symptoms over the past seven days using the depression section of the Hopkins Symptom Checklist (HSCLD) (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974). This scale has been adapted and validated for use in rural Uganda (Ashaba et al., 2018; Bolton et al., 2004; Tsai et al., 2012) and

other geographically and culturally diverse locations (Bolton, Neugebauer, & Ndogoni, 2002; Fawzi et al., 1997; Mollica, McInnes, & Lavelle, 2012). It is comprised of 15 items scored on a 4-point Likert-type scale, which are averaged to obtain the final depression symptom severity score between 1 and 4. In accordance with the scale development study conducted by Bolton & Ndogoni, we added a new item (“don’t care what happens to your health”) and deleted one item (“feeling trapped”) (Bolton & Ndogoni, 2001). The HSCLD measures depression symptom severity and does not provide a clinical diagnosis consistent with the *Diagnostic and Statistical Manual of Mental Disorders*. A score greater than 1.75 has traditionally been employed as the threshold score indicating a positive screen for probable depression, or clinically significant symptoms of depression (Hesbacher, Rickels, Morris, Newman, & Rosenfeld, 1980). Throughout the manuscript we use the term “probable depression” to emphasize that the binary measure does not equate to a diagnosis of major depressive disorder.

**Objective relative wealth:** We measured relative wealth objectively for each participant by asking about the following household possessions and household characteristics: presence of a radio, lantern, bicycle, television, flat iron, motor bike (*boda boda*), refrigerator, stove, or car; number of mobile phones (one, two, or more); number of cows, chickens, and goats; number of land plots; number of rooms in the home; size of the household’s rainwater harvesting tank, if any; type of toilet facility; and predominant materials used in the construction of the household floors and walls. Following previously published work (Filmer & Pritchett, 2001), we applied the method of principal component analysis to these variables – separately within each of the eight villages – to extract the first principal component, which defined the index of household asset wealth relative to other households in the village. Asset index scores have no substantive meaning but can be used to categorize household into quintiles, which we did for each village. Participants in the 4th–5th quintiles were classified as having “below average objective wealth”, while participants in the 1st–3rd quintiles were classified as having “average or above average objective wealth.” Detailed results from principal component analysis are provided in the Supplemental Material, Table S1.

Household assets were elicited from each participant individually. In many instances, several household members reported the assets for the same household. For the present analysis, in households with more than one adult, the asset index was calculated based on the reporting from a single representative of each household (the “head of household”). Although participants were not asked to identify the head of household during the survey, we defined the head of household for the present analysis as the oldest man of reproductive age (18–49 years), consistent with typical elicitations in household surveys (World Bank, 2012). If a household contained no men of reproductive age, the head of household was assigned in the following order of priority: oldest woman of reproductive age, followed by youngest man older than reproductive age, then youngest woman older than reproductive age. The asset index value as calculated for the head of household was then assigned to all members of that household.

**Subjective relative wealth (subjective social status):** Participants were asked to rate, using a 5-point Likert scale, the wealth of their household in comparison with the other households in their village. They indicated whether they perceived their household to be among the five poorest households in their village, worse off than most other households in their village, about the same as most other households in their village in terms of wealth, better off than other households in their village, or among the five wealthiest households in their village. This measure was analyzed as a 5-level ordinal variable. We also dichotomized this measure, as we did for objective relative wealth: participants who reported being among the five poorest households or worse off than most other households were classified as having “low subjective relative wealth,” while participants who reported being about the same/better off than others/among the wealthiest were classified as having “high subjective relative wealth.” Unlike objective relative

wealth which was assigned at the household level, each participant’s own subjective wealth response was used in the analysis.

**Other variables of interest:** Self-reported sociodemographic variables included sex, educational attainment (none, some primary, completed primary, or more than primary), marital status (married/cohabitating, separated/divorced/widowed, or single and never married), and age category (under 25 years, 26–35 years, 36–45 years, 46–55 years, or 56 + years).

### Statistical analysis

Sociodemographic characteristics of study participants within each of the objective and subjective relative wealth categories were tabulated. We fit Poisson regression models with cluster-robust error variance and exchangeable correlation structure to the data to estimate the unadjusted and adjusted associations between objective vs. subjective relative wealth and probable depression. Poisson regression with robust error variance has been found to yield approximate risk ratios when fitting regression models where the dependent variable is binary (Yelland, Salter, & Ryan, 2011; Zou, 2004). Standard errors were adjusted for clustering at the village level. Each multivariable-adjusted regression model included age, sex, education, and marital status, which have been shown in previous studies to be associated with both relative wealth and probable depression. We also assessed for effect measure modification by sex by fitting the regression models within sex strata and then, as a formal test, including product terms between sex and each of the wealth variables in each model.

To explore the possible interaction between subjective relative wealth and objective relative wealth, we conducted an analysis in which the independent variable contained four categories: correctly perceiving wealth as low; incorrectly perceiving wealth as average to high when objective wealth was low; incorrectly perceiving wealth as low when objective wealth was average to high; and correctly perceiving wealth as average to high. We then compared levels of probable depression between people in these four categories.

All analyses were conducted using SAS Version 9.4.

### Sensitivity analyses

In the first sensitivity analysis, we addressed potential discrepancies in household asset reporting. Household asset reporting of study participants residing in households with more than one adult may differ from the reporting by the head of household. Thus, to assess whether our findings could be sensitive to reporting discrepancies, we conducted an analysis in which each study participant was assigned an objective relative wealth value based on the household assets they had reported individually (rather than assigning to them a value based on the household assets reported by their head of household).

In the second sensitivity analysis, we replaced quintiles of objective relative wealth with categories for which participant numbers were closer to participant numbers in the subjective relative wealth categories. Specifically, members of households that were among the five poorest in their village (according to their asset index scores) were placed in the lowest category, members of households that were among the five wealthiest in their village were placed in the highest category, and the remaining households were organized into tertiles representing the middle three categories.

To probe the robustness of our findings to unobserved confounding, we used the e-value method proposed by VanderWeele & Ding (2017). The e-value indicates the magnitude of the association a hypothetical unmeasured confounder would need to have with both household wealth and probable depression to explain away the estimated association (i.e. to shift the confidence interval of the estimate to include a risk ratio of 1). Specifically, we calculated the minimum strength of association, on the risk ratio scale, that an unobserved confounder would be required to have with both subjective relative wealth and

**Table 1**  
Characteristics of the sample according to objective relative wealth category (n = 1,620).

	Objective relative wealth category <sup>a,b</sup>				
	Poorest quintile of asset wealth (n = 217)	Poorer quintile (n = 291)	Middle quintile (n = 362)	Less poor quintile (n = 360)	Least poor quintile of asset wealth (n = 390)
	n (%)	n (%)	n (%)	n (%)	n (%)
<b>Demographic characteristics</b>					
<b>Sex</b>					
Female	128 (59.0)	170 (58.4)	182 (50.3)	190 (52.8)	199 (51.0)
Male	89 (41.0)	121 (41.6)	180 (49.7)	170 (47.2)	191 (49.0)
<b>Age</b>					
18–25 years	42 (19.4)	76 (26.1)	115 (31.8)	107 (29.7)	114 (29.2)
26–36 years	68 (31.3)	84 (28.9)	93 (25.7)	90 (25.0)	97 (24.9)
36–45 years	43 (19.8)	60 (20.6)	66 (18.2)	69 (19.2)	56 (14.4)
46–55 years	36 (16.6)	40 (13.8)	49 (13.5)	52 (14.4)	57 (14.6)
56 + years	28 (12.9)	31 (10.7)	39 (10.8)	42 (11.7)	66 (16.9)
<b>Marital status</b>					
Married/cohabitating	115 (53.0)	181 (62.2)	235 (64.9)	224 (62.2)	230 (59.0)
Separated/divorced/widowed	72 (33.2)	54 (18.6)	41 (11.3)	40 (11.1)	42 (10.8)
Single/never married	30 (13.8)	56 (19.2)	86 (23.8)	96 (26.7)	118 (30.3)
<b>Education</b>					
None	47 (21.7)	53 (18.2)	45 (12.4)	34 (9.4)	27 (6.9)
Some primary school	90 (41.5)	103 (35.4)	103 (28.5)	92 (25.6)	86 (22.1)
Finished primary school	54 (24.9)	63 (21.7)	92 (25.4)	88 (24.4)	78 (20.0)
More than primary school	26 (12.0)	72 (24.7)	122 (33.7)	146 (40.6)	199 (51.0)
<b>Depression</b>					
HSCLD score, mean (sd)	1.7 (0.4)	1.7 (0.5)	1.6 (0.4)	1.5 (0.4)	1.5 (0.4)
Probable depression, n (%)	74 (34.1)	90 (30.9)	92 (25.4)	83 (23.1)	91 (23.3)
<b>Subjective relative wealth</b>					
Among the poorest in village	62 (28.6)	56 (19.2)	36 (9.9)	27 (7.5)	15 (3.9)
Worse off than others	79 (36.4)	75 (25.8)	54 (14.9)	34 (9.4)	18 (4.6)
Average	59 (27.2)	113 (38.8)	187 (51.7)	176 (48.9)	147 (37.7)
Better off than others	12 (5.5)	39 (13.4)	75 (20.7)	97 (26.9)	138 (35.4)
Among the wealthiest in village	5 (2.3)	8 (2.8)	10 (2.8)	26 (7.2)	72 (18.5)

<sup>a</sup> Based on reporting from the oldest man of reproductive age (18–49 years) in the household. If no men were available, this measure was based on reporting from the oldest woman of reproductive age. If no men or women of reproductive age were available, this measure was based on reporting from the youngest man older than reproductive age, then the youngest woman older than reproductive age. The sensitivity analysis described in the Supplementary Material (Table S2) uses individual reporting of assets to determine objective relative wealth categories.

<sup>b</sup> Quintiles of asset wealth were determined with respect to the reporting participant's village.

probable depression (conditional on the measured covariates) in order to explain away the observed association.

## Results

### Descriptive results

The mean depression symptom severity score was 1.60 (s.d., 0.46), and 460 (28.4%) study participants screened positive for probable depression. Compared with people in higher quintiles of asset wealth (objective relative wealth), people in lower quintiles of asset wealth were more likely to be women and to have less formal education (Table 1). Similar patterns were observed in comparing people who perceived their households to be wealthier than other households in their village (subjective relative wealth) vs. people who perceived their households to be poorer (Table 2). Age distributions also varied among the levels of objective vs. subjective relative wealth.

### Objective relative wealth and probable depression

Adjusting for socio-demographic variables (but not subjective relative wealth), quintile of objective relative wealth was not associated with increased risk of probable depression (Table 3, column 1). Adjusted risk ratios ranged from 0.84 (95% confidence interval [CI]: 0.62, 1.14) to 1.06 (95% CI: 0.74, 1.53). The two sensitivity analyses similarly showed that objective relative wealth was not associated with

increased risk of probable depression – either when asset index quintiles were calculated at the individual level rather than at the household level (Supplementary material, Table S2), or when the alternate coding of objective relative wealth was used (Supplementary material, Table S3).

### Subjective relative wealth and probable depression

Adjusting for socio-demographic variables (but not objective relative wealth), lower subjective relative wealth was associated with increased risk of probable depression (Table 3, column 2). The risk of probable depression was greater among people who perceived their households to be worse off than others (i.e., in the next-to-lowest category of subjective relative wealth) (adjusted relative risk [aRR] = 1.63, 95% CI: 1.20, 2.22), and among people who perceived their households to be among the poorest households in their village (i.e., the lowest category of subjective relative wealth) (aRR = 1.78, 95% CI: 1.26, 2.51), compared with the risk among people who perceived their households to be among the wealthiest in the village. The estimated associations between subjective relative wealth and probable depression remained statistically significant after additionally adjusting for objective relative wealth (Table 3, column 3).

In probing our findings for robustness to unobserved confounding, focusing on the association between probable depression and subjective relative wealth (poorest quintile) adjusted for objective relative wealth, the e-value for this estimate was 3.20 (95% CI: 1.64, 5.57). This means

**Table 2**  
Characteristics of the sample according to subjective relative wealth category (n = 1,620).

	Subjective relative wealth category <sup>a</sup>				
	Among the poorest in the village (n = 196)	Worse off than others (n = 260)	Average (n = 682)	Better off than others (n = 361)	Among the wealthiest in the village (n = 121)
	n (%)	n (%)	n (%)	n (%)	n (%)
<b>Demographic characteristics</b>					
<b>Sex</b>					
Female	130 (66.3)	152 (58.5)	332 (48.7)	197 (54.6)	58 (47.9)
Male	66 (33.7)	108 (41.5)	350 (51.3)	164 (45.4)	63 (52.1)
<b>Age</b>					
18–25 years	34 (17.4)	49 (18.9)	189 (27.7)	136 (37.7)	46 (38.0)
26–36 years	59 (30.1)	84 (32.3)	180 (26.4)	86 (23.8)	23 (19.0)
36–45 years	45 (23.0)	53 (20.4)	124 (18.2)	58 (16.1)	14 (11.6)
46–55 years	34 (17.4)	43 (16.5)	95 (13.9)	49 (13.6)	13 (10.7)
56 + years	24 (12.2)	31 (11.9)	94 (13.8)	32 (8.9)	25 (20.7)
<b>Marital status</b>					
Married/cohabitating	116 (59.2)	154 (59.2)	446 (65.4)	210 (58.2)	59 (48.8)
Separated/divorced/widowed	51 (26.0)	71 (27.3)	81 (11.9)	31 (8.6)	15 (12.4)
Single/never married	29 (14.8)	35 (13.5)	155 (22.7)	120 (33.2)	47 (38.8)
<b>Education</b>					
None	41 (20.9)	54 (20.8)	73 (10.7)	26 (7.2)	12 (9.9)
Some primary school	75 (38.3)	100 (38.5)	187 (27.4)	80 (22.2)	32 (26.5)
Finished primary school	52 (26.5)	61 (23.5)	165 (24.2)	76 (21.1)	21 (17.4)
More than primary school	28 (14.3)	45 (17.3)	257 (37.7)	179 (49.6)	56 (46.3)
<b>Depression</b>					
HSCLD score, mean (sd)	1.8 (0.5)	1.7 (0.5)	1.5 (0.4)	1.5 (0.4)	1.5 (0.4)
Probable depression, n (%)	85 (43.4)	92 (35.4)	150 (22.0)	81 (22.4)	22 (18.2)
<b>Objective relative wealth<sup>b</sup></b>					
Poorest quintile of asset wealth	62 (31.6)	79 (30.4)	59 (8.7)	12 (3.3)	5 (4.1)
Poorer quintile	56 (28.6)	75 (28.9)	113 (16.6)	39 (10.8)	8 (6.6)
Middle quintile	36 (18.4)	54 (20.8)	187 (27.4)	75 (20.8)	10 (8.3)
Less poor quintile	27 (13.8)	34 (13.1)	176 (25.8)	97 (26.9)	26 (21.5)
Least poor quintile of asset wealth	15 (7.7)	18 (6.9)	147 (21.6)	138 (38.2)	72 (59.5)

<sup>a</sup> Based on reporting from the oldest man of reproductive age (18–49 years) in the household. If no men were available, this measure was based on reporting from the oldest woman of reproductive age. If no men or women of reproductive age were available, this measure was based on reporting from the youngest man older than reproductive age, then the youngest woman older than reproductive age.

<sup>b</sup> Quintiles of asset wealth were determined with respect to the reporting participant's village.

that the estimated aRR of 1.90 could be explained away by an unmeasured confounder that was associated with both subjective relative wealth and probable depression by a risk ratio of 3.20 each, above and beyond objective relative wealth and the other measured covariates. The lower confidence limit of 1.18 could be explained away by an unmeasured confounder associated with these variables by a risk ratio of 1.64 each. Such a hypothetical confounder would have to be more strongly associated with subjective relative wealth (lowest vs. highest

categories) and depression than sex, which is a well-known and consistent correlate of depression (RR = 1.57 for subjective relative wealth and RR = 1.30 for depression in our data).

#### Interaction analyses

Compared with participants who correctly perceived their relative wealth as being average to high, those who incorrectly perceived their

**Table 3**  
Multivariable-adjusted<sup>a</sup> risk of probable depression among men and women in rural Uganda (n = 1,620).

	Objective relative wealth		Subjective relative wealth		Subjective relative wealth adjusted for objective relative wealth	
	aRR	95% CI	aRR	95% CI	aRR	95% CI
<b>Objective relative wealth</b>						
Poorest quintile of asset wealth	1.09	0.77, 1.55	–	–	0.86	0.58, 1.29
Poorer quintile	1.08	0.79, 1.48	–	–	0.88	0.62, 1.25
Middle quintile	1.00	0.83, 1.19	–	–	0.93	0.76, 1.15
Less poor quintile	0.96	0.68, 1.35	–	–	0.81	0.60, 1.09
Least poor quintile of asset wealth	<i>Ref</i>	<i>Ref</i>	–	–	<i>Ref</i>	<i>Ref</i>
<b>Subjective relative wealth</b>						
Among the poorest in village	–	–	1.82	1.19, 2.81	1.90	1.18, 3.06
Worse off than others	–	–	1.57	1.06, 2.32	1.62	1.06, 2.48
Average	–	–	1.18	0.79, 1.78	1.22	0.81, 1.83
Better off than others	–	–	1.27	0.82, 1.96	1.29	0.84, 1.97
Among the wealthiest in village	–	–	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>

<sup>a</sup> Adjusted for sex, marital status, education level, and age category.

**Table 4**  
Multivariable-adjusted<sup>a</sup> risk of probable depression by combination of objective and subjective relative wealth (n = 1,620).

	aRR	95% CI
<b>Subjective/objective relative wealth</b>		
Correctly perceived as low	1.36	1.13, 1.63
Perceived average-high, truly low	1.14	0.91, 1.42
Perceived low, truly average-high	1.61	1.35, 1.93
Correctly perceived as average-high	Ref	Ref

<sup>a</sup> Adjusted for sex, marital status, education level, and age category.

wealth as low (when it was objectively measured as being average to high) had 1.61 times the risk of probable depression (95% CI: 1.35, 1.93). Similarly, those who incorrectly perceived their relative wealth as average to high had 1.36 times the risk of probable depression (95% CI: 1.13, 1.63), and those who correctly perceived their wealth to be low had a similar risk of probable depression (RR = 1.14, 95% CI: 0.91, 1.42) (Table 4).

We found weak evidence of effect measure modification by sex, with subjective relative wealth being more strongly associated with probable depression among men compared with women (Supplementary material, Table S4). However, in the formal test for interaction, the product terms between sex and each level of subjective relative wealth were not statistically significant.

## Discussion

Using data from a whole-population survey conducted in rural southwestern Uganda, we found that subjective relative wealth was associated with probable depression, while objective relative wealth was not. The association between subjective relative wealth and probable depression remained statistically significant after multivariable adjustment for objective relative wealth and other potentially confounding socio-demographic variables. The estimated association between subjective relative wealth and probable depression was large in magnitude and would require strong confounding by an unobserved variable to be explained away.

Our finding that participants' subjective relative wealth is associated with greater risk of probable depression is consistent with the relative deprivation hypothesis (Marmot & Wilkinson, 2001; Wilkinson, 1996, 1997; Wilkinson & Pickett, 2007). The exact mechanism through which subjective relative wealth exerts its adverse effects on mental health is unclear from our data, but it is possible this phenomenon could be due to social comparisons that bring about feelings of inferiority or unfairness. Our findings are also consistent with the idea that objective and subjective measures of relative wealth are separate constructs (Cundiff & Matthews, 2017; Euteneuer, 2014; Hamad et al., 2008; Singh-Manoux et al., 2003, 2005). Subjective relative wealth was positively associated with objective relative wealth, but the two variables were not perfectly correlated. Subjective relative wealth (i.e., subjective social status) (Davis, 1956; Singh-Manoux et al., 2003) may be a stronger correlate of emotional well-being than objective relative wealth as it more accurately reflects individuals' personal experiences and may capture social position more precisely. Compared to traditional measures of SES (e.g., occupation, education, and income), subjective social status may better reflect the cognitive averaging of multiple dimensions of an individual's specific sociocultural circumstances (Singh-Manoux et al., 2003, 2005). This difference may explain our finding that subjective, but not objective, relative wealth was associated with probable depression.

We did not find evidence that an objective measure of relative wealth was associated with probable depression. While this finding is consistent with prior work in this population (Perkins et al., 2018), it is inconsistent with previous studies that found evidence for a

relationship between objective SES and depression. These studies measured SES using income, education, and/or occupation, rather than wealth (Demakakos et al., 2008; Hoebel et al., 2017). Our study, however, is one of the few studies to estimate the association between objective relative wealth and depression (Osafo Hounkpatin et al., 2015; Perkins et al., 2018). Some studies have found that subjective social status mediates the relationship between objective relative wealth and health outcomes (Wilkinson, 1997). However, we did not assess this mediated pathway because there was no direct association between objective relative wealth and depression. Rather, subjective relative wealth independently predicted probable depression while objective relative wealth, as measured in our study, did not. We did, however, find evidence that incongruence between objective vs. subjective (or, actual vs. perceived) relative wealth was negatively correlated with mental health. Specifically, participants with average to high objective relative wealth who (incorrectly) perceived themselves to be poorer than average had a greater risk of depression compared with participants with the same level of objective relative wealth who (correctly) perceived that they were not poorer than average.

Consistent with previously published studies (Jaffe et al., 2005; Kondo et al., 2015; Yngwe et al., 2003), we found that subjective relative wealth was more strongly correlated with probable depression among men than among women. The reasons for this difference are not well-known but may be related to men's principal roles in income generation for their households. A seminal study of water insecurity and emotional distress (Wutich, 2009) describes how the "breadwinner" role affects men's feelings of shame and distress about their families' suffering. The same mechanisms may explain the observed discrepancies between men and women observed in our study. Further qualitative study is needed, however, to better understand these sex-based differences.

Our findings should be considered in light of several limitations. First, given the cross-sectional nature of the data, this analysis assumes that relative wealth and perceptions of relative wealth preceded depressive symptoms for all participants. However, it is possible that depression is a cause of lower wealth accumulation or that depression and wealth are mutually causal over time (Collins & Goldman, 2008; Lund et al., 2010, 2011). Existing literature largely supports our assumption about temporality (Hanandita & Tampubolon, 2014; Muntaner et al., 2004), although one study found that cross-sectional studies may overestimate the strength of the association between perceived social position and health (Collins & Goldman, 2008). It is also possible that having depression leads to stricter social comparisons and thus lower subjective wealth reporting. Second, our findings based on relative wealth measures hold only for a specific, geographically-based reference group (i.e. village of residence). We selected village of residence on the basis of convenience and because it is fairly easy to define in this cultural context. However, alternate reference groups, such as groups similar in terms of age, sex, or other characteristics, may be more appropriate (Eibner & Evans, 2005; Mangyo & Park, 2011; Wolff, Subramanian, Acevedo-Garcia, Weber, & Kawachi, 2010). Future research may consider defining the reference group in a different manner. Third, in this cultural context, wealth is considered a household construct; therefore, asset index assignment was based on the reporting of a single member of the household whom we determined to be the head of household. Head of household determination was based on an age/sex algorithm consistent with how household headship is commonly operationalized. However, it is possible that household headship was assigned incorrectly – especially in extended family arrangements and situations in which an older relative is staying with a younger relative – and the objective level of wealth in the household may therefore have been less accurately classified as a result. To address this concern, a sensitivity analysis using each individual's asset index value based on their own reporting yielded results that were similar to those obtained in the primary analysis.

A final limitation relates to the possibility of measurement error and/or confounding related to negative affect. In the analysis of subjective relative wealth and depression, misclassification of depression status could have been differential if people with lower subjective wealth were more likely to be currently experiencing negative emotions and thus more likely to overreport their depressive symptoms. This could cause bias away from the null. Additionally, confounding by negative affect could have biased estimates away from the null. Nevertheless, the e-value analysis bounds the magnitude of the potential bias: confounding by an unmeasured variable like negative affect would need to be quite strongly correlated with both subjective relative wealth and depression in order to explain away the estimated association.

In summary, this analysis of whole-population data from rural southwestern Uganda distinguishes between objective vs. subjective measures of relative wealth and contributes a greater understanding of the relative importance of each measure in predicting mental health status. Our findings support the idea that subjective relative wealth is strongly correlated with depression in this population. Wealth may be related to mental health through channels other than absolute resource availability. Interventions, such as cash transfer programs (Owusu-Addo, Renzaho, & Smith, 2018), that directly provide resources have been found to positively affect health. However, our findings suggest that improvements to mental health may depend more on subjective assessments of wealth relative to others, rather than actual relative wealth.

### Ethics approval

Ethical approval for this study was received from the Partners Human Research Committee at Massachusetts General Hospital and the Research Ethics Committee at Mbarara University of Science and Technology. Consistent with national guidelines, we also received clearance for the study from the Uganda National Council of Science and Technology and the Research Secretariat in the Office of the President.

### Declaration of interests

We declare no conflicts of interest.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2019.100448>.

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