Title: Gender differences in factors associated with depressive symptoms among couples in Kumasi, Ghana

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Abstract: Depression is an important public health issue in low-income settings in terms of disease burden and gender disparities. Using couples data from the Family Health and Wealth Study in Kumasi, Ghana, we conducted a series of Tobit regression models to identify factors associated with depressive symptoms. The following characteristics were associated with more depressive symptoms for men: lower relative socioeconomic status, higher education difference with his partner, more biological children, higher commitment, higher trust, lower communication, higher partner's depressive symptom score and lower partner's trust. The following characteristics were associated with more depressive symptoms for women: being Christian vs. Muslim, poorer self-rated health, and higher partner's CES-D score. In the final combined model, there were significant interactions between sex and relative SES, and sex and self-rated health. These findings provide evidence of gender differences in factors associated with depressive symptoms, and indicate directions for future research and interventions.

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Introduction

Depression is an important public health issue globally, including in low-income countries. (1) Research in diverse populations indicates that depression is approximately twice as common for women as it is for men. (2-4) These gender differences are commonly attributed to a combination of diathesis and stress factors. (4) Despite the public health importance of this issue, very little research has been done on depression in sub-Saharan Africa, and specifically on gender differences. This study aims to expand the evidence base on this issue by exploring factors associated with depressive symptoms among 542 couples in Kumasi, Ghana.

Gender and depressive symptoms

Unipolar depressive disorder is the leading cause of disease burden (morbidity and mortality combined) for women globally, including in low-income countries, according to the World Health Organization's (WHO) 2004 Global Burden of Disease (GBD) Study. (1) The study also estimated that this condition is the third most important cause of disease burden globally for men and women combined, and the eighth most important in low-income countries. (1) Tomita and colleagues found that depressive symptoms were significantly higher for women than men in a nationally representative survey in South Africa. (5) Chipimo and colleagues also found mental distress to be significantly higher among females than males in Zambia. (6) In a review of the evidence on sex differences in depression, Parker and Brotchie weigh arguments in favor of both an artifactual explanation (e.g. women are more likely to seek help) as well as real differences in risk (e.g. women are biologically more predisposed to developing depression; women are exposed to more risk factors for depression). (3) The authors note evidence that gender differences are less pronounced in homogeneous community samples (e.g. by education, culture), indicating the potentially important role of social factors in driving this difference. They conclude that women are both more

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predisposed to depression (i.e. due to biological or genetic factors) and are also exposed to greater social stressors, increasing their risk further. (3)

Mental health and depression in Ghana

Although nationally representative data on mental health in Ghana do not exist, several smaller studies have addressed this issue. Through the Women's Health Study, following 2814 adult women from the Accra area, de Menil and colleagues found that low levels of education, poverty, and unemployment were associated with poor mental health. In addition, women who reported either taking prescription medication, or having headaches in the last month, or women who had ever been pregnant were significantly more likely to report higher mental illness symptoms. Only 0.3% of women reported symptoms consistent with the U.S. cutoff for a mental health disorder on the K6 instrument, indicating that a different cutoff might be more appropriate in this setting. (7) A recent study on bullying and mental health with senior high school students in Ghana found that 16.5% of students reported suicidal ideation in the previous year, although a more complete measure of depressive symptoms was not included. (8) Finally, in a hospital sample of pregnant women in Kumasi, Ghana, Bindt and colleagues found that 27% of women met criteria for major depression, and depression accounted for a substantial proportion of self-reported disability. (9)

Through the Mental Health and Poverty Project (MHaPP), Ofori-Atta and colleagues conducted a qualitative study with healthcare providers from five regions in Ghana to explore local understandings of mental illness. They found that respondents attributed mental illness in women to three main causes: inherent vulnerability (e.g. women cannot handle stress as well as men), witchcraft, and gender disadvantage (polygyny, physical abuse, and poverty). (10) Another recent study on mental health in Ghana examined official police records to assess reasons for suicidal

behavior. Although social stigma and the threat of prosecution for survivors likely produced biased data, the authors found that 95% of people undertaking reported suicidal behavior between 2006 and 2008 were men, and the most common reason attributed to the behavior was to avoid public dishonor (34%), while an additional 10% were attributed to sexual impotence or suspecting a wife/partner of having an affair. (11)

Methods

Study site

The data for these analyses come from the Family Health and Wealth Study (FHWS) in Ghana. FHWS is a multi-country longitudinal open cohort study that aims to examine individual and household level health and economic consequences of family size. The FHWS survey is administered individually to husband-wife (or cohabiting) pairs, and includes questions on the following areas, among others: contraceptive use, fertility history, fertility preferences, health status, socio-economic status, and relationship quality. The Ghana FHWS study communities are located in Kumasi, the second largest city in the country, in the Ashanti administrative region. Participants were recruited from four neighboring sites in the Asawase sub-metropolitan area in peri-urban Kumasi. Prior to recruitment for this study, a household enumeration was undertaken in the target communities to inform a sampling frame. Exclusion/inclusion criteria were also established, which included age (15-44 for women, 18-59 for men), relationship status (married or cohabiting), and residence within the study area. These criteria, along with the sampling frame, were used to randomly select households for participation.

At baseline in 2010, the Ghana FHWS enrolled a cohort of 799 households. The response rate was 96.7% (27 couples declined participation). The FHWS follow-up survey, administered from 2011-

2012, included similar questions to the baseline survey. The study team was able to locate 644 out of the original 799 couples (81%). The primary reasons for loss to follow-up were migration due to work and loss of residence. The average lag time between baseline and follow-up survey administration within households was nineteen months. An additional 168 couples were recruited at follow-up and provided responses to the baseline FHWS survey. In 2012, the FHWS study team collected data on depressive symptoms from adult male and female study participants. They identified 704 men (87% of follow-up respondents) and 757 women (93% of follow-up respondents) in the study population. The average lag time between the follow-up survey administration and depressive symptom data collection was 10 months. All participants provided informed consent, obtained through culturally appropriate procedures, before participation.

The Ghana FHWS is implemented in collaboration with the Kwame Nkrumah University of Science and Technology (KNUST), whose researchers have extensive experience conducting similar research. KNUST has a close partnership with the Bill & Melinda Gates Institute for Population and Reproductive Health at the Johns Hopkins Bloomberg School of Public Health.

Key variables

Depressive symptoms were assessed using a 10-item version of the Center for Epidemiologic Studies Depression (CES-D) Scale. (12) The CES-D was designed as a self-reporting tool that can be administered by lay interviewers. In contrast to diagnostic tools used during clinical intake, the CES-D was developed to measure depressive symptoms – with a focus on depressed mood – that might accompany different clinical diagnoses, including normal. (13) The 20 items included in the original scale were identified from existing self-reporting tools (e.g. Beck Depression Inventory), clinical literature, and factor analysis. (13) Validity and reliability of the original scale was assessed in U.S.

psychiatric clinic and population samples. These tests revealed acceptability, criterion validity, construct validity, and high internal consistency. Numerous shortened versions of the CES-D scale have been validated. (12,14) In order to limit the burden of an additional scale on study participants, we chose to use a 10-item version of the CES-D with two response options (yes/no), which was previously validated by Irwin and colleagues in an elderly U.S. population. (12) Using a sum score of responses to all ten items, and a cutoff of four depressive symptoms, Irwin and colleagues found that this 10-item version of the CES-D had a sensitivity of 97% and specificity of 84%. (12) Analysis of the psychometric properties of the CES-D scale in this population indicate strong internal consistency reliability and validity (results not shown). A high proportion of variation in all ten scale items was explained by one underlying factor, depressive symptoms. Table 1 provides the 10-item version of the CES-D scale used in this study. The remaining variables used in this study were assessed during the FHWS follow-up data collection round. They include: relationship quality, self-rated health, socioeconomic status, and all other independent variables.

The FHWS includes four relationship quality scales, each focused on a different dimension of relationship quality: communication, trust, satisfaction, and commitment. Respondents were asked to indicate how much they agree with a series of statements about their relationship, e.g. *my partner treats me fairly and justly*, or how often a certain behavior occurs, e.g. *how often do you confide in your partner?* Each of the original scales includes five to eight questions, and women and men responded separately to each question. Previous research on the psychometric properties of the relationship quality scales in this population suggests a series of modifications, which we have integrated into our analyses. The modifications include the use of shortened versions of the commitment and trust scales, one question on relationship satisfaction, and two separate communication scales – one on destructive communication and one on constructive communication. (15)

Self-rated health was measured in the FHWS survey through one question: *Tell me, please, how would you evaluate your health? Is it very good, good, average (not good, but not bad), bad, very bad?* Previous research indicates that self-rated health, adjusted for age, is a reliable predictor of mortality in diverse populations. (16-18) In addition, numerous studies have found significant associations between poor self-rated health and mental illness. (6,19)

Relative SES was measured in the FHWS using the following question: *Imagine a 9-step ladder where on the bottom, the first step, stand the poorest people, and on the highest step, the 9th, stand the rich. On which step is your family located today?* In addition to the question on relative SES, the FHWS included diverse questions on household wealth, income, and expenditures, including questions on whether the household owns a series of assets, land ownership, and recent medical expenditures. The wealth portion of the FHWS survey was administered to men only, and their responses were applied to the entire household, including their wives/partners. A combination of responses to these questions were also used to create a measure of absolute socio-economic status, based on the methodology used by the Demographic and Health Surveys (DHS). (20) We ultimately chose to use relative SES in our analyses because it is a subjective measure, and has previously been shown to be more strongly associated with mental illness than absolute measures of SES. (21)

Based on a review of the literature, and previous qualitative research in the study community, we selected the following individual and household characteristics to include in our analyses: religion, marriage type, education, age, parity, and pregnancy/post-partum status for women. We also included age and education differences within couples as a measure of power within relationships.

Data Analysis

Since the goal of these analyses was to look at similarities and differences between men and women in couples, we selected the subset of 542 couple pairs (i.e. 542 men and 542 women) for whom complete data were available. This represents 71% of men and 69% of women who provided follow-up data for the FHWS. We chose not to impute missing values for the outcome or for our primary independent variables of interest. For other variables we noted that individuals tended to have missing data on multiple items, which informed the decision to only analyze data from couples with complete data available.

Approximately 56% of respondents in the analytic sample reported no depressive symptoms (54% of men and 58% of women) (see Figure 1). As a result, the distribution of the dependent variable violates the assumptions of ordinary least squares (OLS) regression, meaning that OLS would produce biased estimates. (22) Tobit models have been used increasingly in social science literature to account for data censoring at the lower and/or upper level of the outcome variable. (22-24) This method has been used for regression models predicting CES-D scores given the common clustering of observations at the lower and upper levels. (25) In contrast to interpretation of OLS coefficient estimates, Tobit coefficients can be interpreted as representing the association between each independent variable and an underlying latent unobserved outcome. (22) The estimates produced by Tobit models can be decomposed and interpreted in two parts: 1) the effect of each independent variable on the value of the dependent variable (CES-D score) among those with a CES-D score greater than zero (non-limit value); and 2) the effect of each independent variable on the probability of having a non-limit value (i.e. CES-D score > 0) among respondents with a CES-D score of zero. (23) We conducted the same analyses described below using OLS regression and the results were similar (data not shown).

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Before beginning data analyses we examined the distribution of CES-D score, the dependent variable, and each independent variable of interest. Given the research focus on gender differences, we then statistically compared mean values and proportions of each variable between men and women in the study population. We conducted t-tests for differences in mean values of continuous variables, and one-way anova tests for differences in proportions of categorical variables.

As a next step, we examined bivariate relationships between CES-D and each independent variable of interest. We ran simple Tobit regression models between each independent variable and CES-D score for men and women separately. In each model we controlled for clustering by study site, which resulted in unchanged mean estimates, but adjusted the standard errors of each estimate to take into account the similarities between individuals living in the same study sites. (26)

As a final analytic step, we conducted a nested series of Tobit regression models to assess associations between independent variables of interest and CES-D scores. We first ran these models stratified by sex, and then ran a full model including both men and women, adjusting for sex to test for statistical interaction. In each set of models (men, women, combined) we added variables in three consecutive blocks: individual/household characteristics (religion, marriage type, relative SES, education, education difference between partners, age, age difference, parity/biological children, and pregnant/post-partum for women only); relationship quality and self-rated health (four relationship quality scales and self-rated health); and partner characteristics (partner's CES-D score and partner's four relationship scales). We chose to include partner characteristics in order to assess the extent to which a respondent's partner's depressive symptoms and perceptions of relationship quality were associated with his or her own level of depressive symptoms. In the final set of combined regression models for men and women we included interactions between sex and other independent variables

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that appeared relevant based on our a priori assumptions and the results of the sex-stratified models. All regression models adjusted for clustering by study site. (26)

Tobit regression in STATA/SE version 13.0 produces estimates of the marginal effects of each independent variable on the latent dependent variable, in this case latent CES-D score. The user-generated dtobit2 package then calculates estimated mean effects of independent variables unconditional on censoring, conditional on censoring, and finally the change in probability of censoring associated with each independent variable. (27) For the purposes of these analyses, we have first focused on highlighting the risk and protective factors that are statistically significantly associated with the outcome; these variables remain the same regardless of the type of effect estimate. We then examine the conditional effects in each model more closely, which represent estimates of the effect that each independent variable has on increasing (or decreasing) CES-D score among those who have a CES-D score larger than zero. (22-24) Last, we present the effect of each independent variable on the probability that individuals with a CES-D score of 0 will develop any depressive symptoms. All analyses were conducted using STATA/SE version 13.0.

Ethical approvals

The FHWS was approved by the Committee on Human Research Publication and Ethics at the Kwame Nkrumah University of Science and Technology-School of Medical Sciences/Komfo Anokye Teaching Hospital in Kumasi, Ghana. This secondary data analysis study was approved by the Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health.

Results

Sample characteristics

Table 2 presents sample characteristics by sex. In the full sample, the mean CES-D score for women (2.6) was significantly higher than the mean score for men (2.1, p = 0.02). Using the cutoff of at least four symptoms identified by Irwin and colleagues, 27.3% of men and 31.2% of women were categorized as having high levels of depressive symptoms. (12) Mean level of education (p = 0.003) and mean age (p < 0.0001) were both higher for men than women. Men reported a higher mean number of biological children than women (parity) (p = 0.03). Men also reported higher levels on all four relationship quality scales: commitment (p <0.0001), trust (0.09), communication (<0.0001), and satisfaction (<0.0001). Women reported significantly poorer self-rated health compared to men (p = 0.0001). There were no statistically significant differences between men and women on reported religion or marriage type. Approximately 9.4% of women were categorized as pregnant or post-partum based on their responses during the follow-up survey. The mean reported level of household relative SES was 4.4.

Unadjusted analyses

Table 3 presents the results of bivariate Tobit regression models between each independent variable and latent CES-D score, adjusted for clustering by site. For both men and women, being Muslim (vs. Christian) was significantly associated with a lower latent CES-D score (p = 0.01 for men and women). For men, being in a polygynous (vs. monogamous) relationship was associated with a lower latent CES-D score (p < 0.0001), but there was no significant difference for women (p = 0.84). For women, older age was associated with a higher latent CES-D score (0.04), but there was no difference for men (p = 0.32). In terms of relationship quality, better communication and higher satisfaction were associated with lower latent CES-D scores for both men (communication p-value

= 0.005, satisfaction p-value = 0.03) and women (communication p-value < 0.0001, satisfaction p-value = 0.02). In addition, for women higher trust was associated with lower latent CES-D scores (p = 0.04). Finally, for women poorer self-rated health was associated with a higher latent CES-D score (p = 0.04).

Adjusted Analyses for Men and Women Separately

In the final men's regression model (Table 4.a), the following characteristics were associated with more depressive symptoms: lower relative SES, higher education difference with his partner, more biological children, higher commitment, higher trust, lower communication, higher partner's CES-D score and lower partner's trust (column A). Among men who reported any depressive symptoms, a one point increase in relative SES was associated with 0.27 point lower mean CES-D score; and one additional biological child was associated with a 0.01 higher mean CES-D score. In the same group of men, a one-year increase in education difference with his partner was also associated with a 0.04 point increase in CES-D score. In terms of relationship quality, among men who reported any depressive symptoms: a one point increase in commitment was associated with a 0.11 point increase in CES-D score; a one point increase in trust with a 0.05 point increase in CES-D score; and a one point increase in communication with a 0.10 point decrease in CES-D score. Also, a one point increase in wife's trust score was associated with a 0.06 point decrease in CES-D score for men who report any depressive symptoms and a one point increase in wife's CES-D score was associated with a 0.13 point increase in men's CES-D score, among men who report any depressive symptoms. Column 3 presents the effect of each independent variable on the probability that men with a CES-D score of 0 will develop any depressive symptoms. For example, among men reporting no depressive symptoms, a one-point decrease in relative SES was associated with a 7.3% increase in the probability of reporting any depressive symptoms. Also in this censored group of men, a one-

point increase in wife's CES-D score was associated with a 3.3% increased probability of reporting any depressive symptoms.

In the final women's regression model (Table 4.b), the following characteristics were associated with more depressive symptoms: being Christian vs. Muslim (p = 0.02), poorer self-rated health (p < 0.0001), and higher partner's CES-D score (p = 0.04). Among women who reported any depressive symptoms (column B), being Christian was associated with a 0.80 point lower mean CES-D score, and a one point increase in self-rated health (toward poorer health) was associated with a 0.48 point increase in CES-D score. Also in this group of uncensored women, a one point increase in partner's CES-D score was associated with a 0.20 point increase in women's CES-D score. The estimated changes in the probability of being uncensored (column C) indicate that, among women who reported no depressive symptoms, being Christian instead of Muslim is associated with a 14.5% higher probability of reporting any depressive symptoms. Also among women reporting no depressive symptoms, a one point deterioration in self-rated health was associated with a 8.6% increased probability of reporting any depressive symptoms, and a one point increase in husband's CES-D score was associated with a 3.5% increased probability of reporting any depressive symptoms.

Adjusted Analyses for Men and Women Combined

The final combined regression model for men and women (Table 5) echoes many of the findings from the men's and women's individual models. The following characteristics were associated with a higher value on the latent variable measuring depressive symptoms: having a larger education difference with one's partner, higher commitment, lower communication, and partner's higher latent CES-D score. There were also significant interactions between sex and relative SES, and sex and

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self-rated health. For men, a higher relative SES level was associated with lower latent CES-D score, while for women the reverse was true. Similarly, for women better self-rated health was associated with lower latent CES-D score, while for men the reverse was true. Among men and women who reported any depressive symptoms (column B), a one point increase in relationship commitment was associated with a 0.03 point increase in CES-D score, but a one-point increase in relationship communication was associated with a 0.04 point decrease in CES-D score. A one-year increase in education difference between partners was associated with a 0.02 point increase in CES-D score, conditional on being uncensored. Also, a one-point increase in partner's CES-D score was associated with a 0.16 point increase in respondent's CES-D score.

Reflecting the individual models, the sex by relative SES interaction effect indicates that a one-point increase in relative SES was associated with a 0.29 point decrease in CES-D score for men, but a 0.03 point increase in CES-D score for women, conditional on being uncensored. The sex by self-rated health interaction effect indicates that a one-point increase in self-rated health (toward poorer health) is associated with a 0.17 point decrease in CES-D score for men, but a 0.41 point increase in CES-D score for women, conditional on being uncensored. Among men and women who report no depressive symptoms, a one-point increase in partner's CES-D score is associated with a 3.4% increased probability of reporting any depressive symptoms. The interaction effect between sex and relative SES indicates that, among men who report no depressive symptoms, a one point decrease in relative SES is associated with a 6.9% increase in the probability of reporting any depressive symptoms, while for women in the same situation, this change is associated with a 1.1% decrease in the probability of reporting any depressive symptoms. Similarly for the sex by self-rated health interaction, among women who report no depressive symptoms, a one point deterioration in self-rated health is associated with an 8.1% increased probability of reporting any depressive symptoms,

while for men in the same situation, this change is associated with a 3.3% decrease in the probability of reporting any depressive symptoms.

Discussion

In this study, we explored factors associated with depressive symptoms among couples in Kumasi, Ghana using multivariable Tobit regression models. While a strong body of literature exists on risk and protective factors for – as well as gender differences in – depression in high-income countries, this topic has not been sufficiently explored in sub-Saharan Africa. (28)

Factors associated with depressive symptoms

Using responses to a ten-item version of the CES-D, participants in this study were each assigned a CES-D score ranging from 0 to 10. Overall men and women reported significantly different mean levels of depressive symptoms, as well as different levels of all independent variables, except marriage type and religion. An individual who reports a high level of depressive symptoms on the CES-D might have a disorder, but might also be mourning the loss of a child, have a medical condition causing these symptoms, or might not meet the criteria for a disorder for many other reasons. A diagnostic assessment would be needed to determine whether someone with a high level of depressive symptoms has a depressive disorder. Although the CES-D is not diagnostic, it was designed to be sensitive to levels of depressive symptomology severity, and to certain life events. Tools assessing depressive symptomology can be used to identify high-risk population groups in need of intervention, and to identify correlates of depressive symptoms, but individual scores should not be interpreted. (13)

In all final Tobit regression models (men, women, combined), respondent's CES-D score was significantly positively associated with his or her partner's latent CES-D score. For women, being Muslim and having better self-rated health were also significantly protective against depressive symptoms. For men, higher relative SES, fewer biological children, and lower age difference with his partner emerged as protective individual/household characteristics. Also for men, the picture of risk was more complex with regard to relationship quality. While a higher level of men's *own trust* in their partners was associated with a higher average CES-D score for men, a higher level of *their partner's trust* was associated with a lower average CES-D score for men. Also, men's higher commitment score, but lower communication score, were both associated with a higher latent CES-D score for men. In the combined men's and women's models, some of these differences persisted. As was the case with the men's models, good communication was again protective, while higher commitment was associated with more depressive symptoms, although these effects were both attenuated compared to the men's model. Similarly, education difference between partners was positively associated with CES-D score in the combined model, but attenuated relative to the men's model. There were two important interactions with sex in the combined model: with relative SES and self-rated health, reflecting the different relationships between each of these variables in the men's and women's individual models. Higher relative SES was associated with lower CES-D score for men, but higher CES-D score for women. Poorer self-rated health was associated with lower CES-D score for women, but higher CES-D score for men.

Depression, couples and relationship quality

For both men and women in this study, partner's depressive symptoms were significantly associated with the respondent's depressive symptoms, independent of their own individual, household, and relationship quality exposures. This reflects other research findings that depression clusters within

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families, friend groups, and neighborhoods. (29,30) Rosenquist outlines three possible explanations for this clustering of depression: 1) induction, where depression in one person causes depression in another, 2) homophily, when depressed individuals choose one another as partners or friends, or 3) confounding, where individuals experience the same events that increase their risk of depression. (30) The possible role of confounding is likely stronger in married couples than other groups, given their joint exposure to economic, health, and other stressors. Given that depressive symptoms were only measured at one time point in this study, it is difficult to assess the role of induction or homophily. In terms of confounding, the interactions between sex and self-rated health and sex and relative SES indicate that, at least in part, men and women in the study population were subject to different risk factors for depressive symptoms.

There is also evidence in our results, as well as previous research, that relationship quality plays a role in increasing or buffering the risk of depression in couples. We examined associations between depressive symptoms and four dimensions of couple relationship quality: commitment, communication, trust, and satisfaction. Relationship satisfaction was not significantly associated with depressive symptoms in any of the Tobit regression models. In the men's models and combined models, higher commitment appeared to increase risk of depressive symptoms, while better communication appeared to be protective. Whitton and colleagues found that relationship characteristics, such as level of commitment and interdependence, moderated the association between satisfaction and depressive symptoms in young American adults. They describe the potentially different role that commitment plays in relationships for men compared to women, arguing that men prioritize the good of a relationship over their own immediate self-interest only when they feel a high level of commitment, whereas women tend to prioritize the good of the relationship regardless of commitment level. (31) In that context, the results of this study related to

commitment might reflect a perception by men that increased relationship commitment is associated with increased responsibilities and reduced focus on his own immediate self interest. In contrast to the findings on commitment, higher relationship communication, measured by high constructive communication and low destructive communication in this study, was protective against depressive symptoms. This is consistent with previous research on conflict in relationships as a risk factor for depression. Beach and colleagues investigated cross-spouse effects of marital discord on depressive symptoms over time in a sample of American married couples. They found that reports of marital discord at baseline predicted depressive symptoms at follow-up for men and women themselves, as well as for their partners, and that the magnitude of these effects was comparable for men and women. (31) More broadly, Teo and colleagues found that, among adult Americans with and without a history of major depression at baseline, both relationship quality with a spouse and relationship quality with other family members predicted risk of major depression at follow-up. They also found that both negative and positive aspects of relationships, i.e. strain and support, were independently associated with depression. (32) Although research on sex differences in the effect of relationship quality on depression is inconclusive, Beach and colleagues argue that there is theoretical reason to believe that sex differences diminish in longer-term relationships as men's and women's levels of commitment converge. (29)

SES, depression and gender

In this study, there was a statistically significant interaction effect between sex and relative SES; better SES was associated with higher depressive symptoms for men, but lower depressive symptoms for women, the latter of a smaller magnitude. In addition, increased education difference between men and women was associated with a higher latent CES-D score in the combined models. Previous research indicates that both poverty and education likely have a two-way relationship with

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depression. Skeen and colleagues describe social causation theory, which argues that people living in poverty are at an increased risk of developing mental disorders due to factors such as stress and malnutrition, while social drift theory argues that people living with mental disorders are also more likely to fall into poverty due to exclusion and stigma. (33) Given the consistent negative association between SES and depression in the literature, (34) the positive association for women in this study is somewhat surprising. In a cross-national study of depression in 23 European countries, Van de Velde and colleagues found that SES moderated the relationship between sex and depression. For example, retired men were significantly more likely to be depressed than working men, but this difference was not observed for retired women. Similarly, education was more strongly protective against depression for women than men. Despite this interaction between sex and SES, overall they found that respondents with higher levels of absolute SES tended to have lower risk of depression. (2)

We chose to include a measure of relative rather than absolute SES in our models given previous literature indicating that relative SES is more closely associated with mental health, (21,35) and the important role of perception in stress. However, it is possible that women's assessments of relative SES would have been different from men's, which might have accounted in part for the different relationship between SES and depressive symptoms for men and women. For the purpose of comparison, we also developed a measure of absolute SES, by conducting a principal components analysis with a series of assets, (20) which was not significantly associated with CES-D score in unadjusted or adjusted models. No other associations changed substantively when we included absolute SES instead of relative SES in the model. When we included both relative SES and absolute SES, all conclusions remained the same except that communication and the sex by self-rated health interaction were no longer statistically significant (results not shown).

Self-rated health, depression, and gender

Overall, women in this study reported poorer self-rated health, and higher levels of depressive symptoms, which is consistent with research in other populations. (18) Further, poorer self-rated health was associated with higher depressive symptoms for women, but lower depressive symptoms for men. In contrast, some studies have found that self-rated health is more strongly associated with mortality for men than for women. (16,17) In addition to extensive research supporting an association between self-rated health and mortality, (16-18) numerous studies have also found that self-rated health is a significant predictor of mental distress or illness. Tomita and colleagues found that poorer self-rated health was associated with a higher level of depressive symptoms for men and women in South Africa, although they did not examine whether this mechanism was different for men and women. (5) According to Jylha, the cognitive process of rating one's health takes into account numerous factors, including cultural conceptions of health, individual expectations of health, and positive or negative disposition, including depression status. (16) This difference in the effect of self-rated health for men and women potentially reflects a difference in the cognitive process that men and women adopt for assessing their health, such as a greater emphasis on mental health factors by women compared to men.

Strengths and limitations

This study has some important limitations. The timing of data collection on depressive symptoms – which took place on average ten months after the data collection on other variables – creates the possibility of misclassification. For example, it is possible that household relative SES status changed for some respondents during the ten months between data collection. However, given our interest in understanding how acute and chronic exposure to stressors might increase risk of developing depressive symptoms, some lag time between exposure to stressors and measurement of depressive

symptoms was desirable. In addition, missing data on key covariates, and the desire to analyze data for complete couples, required that we use only a subset of the data available. To assess the impact of the missing data, we used hotdeck multiple imputation to replace missing data, and re-estimated the bivariate models in Table 3. The directions and approximate magnitude of all estimates remained the same, although several estimates changed statistical significance (satisfaction for men; education, education difference, and parity for women). Last, the Family Health and Wealth Study did not collect data on some key risk factors for depressive symptoms that emerged from a previous literature review and qualitative research, including intimate partner violence and infertility. (36-38)

Despite these limitations, this study has several important strengths. Depression in couples is an important topic in sub-Saharan Africa in terms of disease burden, (1) but has been understudied to date. The use of couples data allowed us to examine the effects of partner and relationship characteristics on men's and women's risk of developing depressive symptoms. Inclusion of partner's depressive symptoms in our analyses provided information on the clustering of depressive symptoms within couples. Given the interest in gender roles, inclusion of four scales measuring relationship quality was also a useful addition. Previous qualitative research used to inform this study indicated that relationship quality was an important cause of depressive symptoms for men and women in the study population.

Future directions

The results of our analyses indicate that factors associated with depressive symptoms differ for men and women in the study population. This is evidenced by the different results in the men's and women's models, as well as the significant interaction effects between sex and self-rated health and relative SES. Future research should explicitly address and explore gender differences in causes of

depression, either through separate models or interaction effects. In addition, our results indicate the importance of partner characteristics, especially partner's level of depressive symptoms, in predicting individual depressive symptoms. Future research should also focus on longitudinal exposures and repeated measures of depressive symptoms in couples, as well as symptoms of other common mental health disorders. Quantitative research on mental health should be complemented by qualitative research to inform interpretation of results and help identify additional important risk and protective factors for consideration. Also, given evidence that marriage is associated with lower levels of depression in many populations, (2) future research should explore risk and protective factors for depression among single men and women of all ages.

Policy and program implications

The results of this study indicate that depression prevention and treatment interventions with married or cohabiting individuals should involve both partners. The important role of depressive symptoms in the study site also underlines the need for efforts to integrate depression screening into primary healthcare services. Associations between depressive symptoms and self-rated health for women also point to an opportunity to supplement physical screening practices with patients' inputs on their own health. More broadly, continued efforts are needed in contexts similar to the study population to raise awareness about symptoms of depression and sources of care in the community.

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Tables and Figures

Table 1. Questions from the ten-item version of the Center for Epidemiologic Studies Depression Scale

Item	Question (in the past week…)
	Response Option: Yes, No
1	I felt depressed
2	I felt everything I did was an effort
3	My sleep was restless
4	I was happy
5	I felt lonely
6	People were unfriendly
7	I enjoyed life
8	I felt sad
9	I felt that people disliked me
10	I could not get going

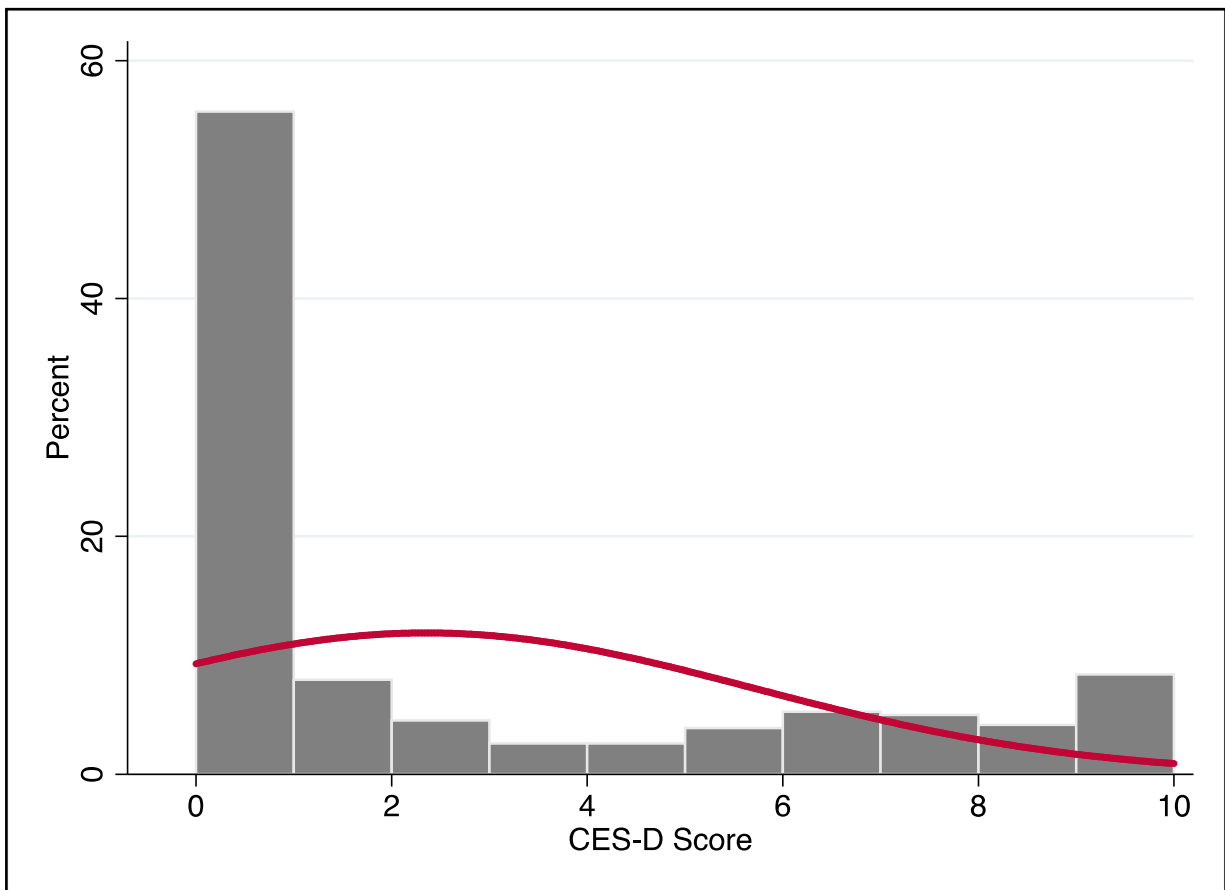*Figure 1. Histogram of CES-D scores by sex and normal distribution line (n = 1084)*

Table 2. Key Variable Means/Proportions by Sex (n = 1084)

	Men	Women	p-value
	(n = 542)	(n = 542)	--
CES-D score Mean (range)	2.1 (0-10)	2.6 (0-10)	0.02
Religion (% Christian)	51.3	52.6	0.67
Marriage type (% polygynous)	8.1	10.2	0.25
Relative SES Mean (range)	4.4 (1-8)	--	--
Education, years Mean (range)	7.0 (0-22)	6.2 (0-16)	0.003
Age, years Mean (range)	42.3 (24-56)	34.8 (20-47)	<0.0001
Parity, number Mean (range)	3.8 (0-30)	3.5 (0-10)	0.03
Pregnant/post-partum (% yes)	--	7.9	--
Commitment Mean (range)	32.6 (8-36)	29.8 (7-36)	<0.0001
Trust Mean (range)	27.3 (10-35)	26.8 (7-35)	0.09
Communication Mean (range)	19.6 (0-27)	16.6 (-20-27)	<0.0001
Satisfaction Mean (range)	5.0 (1-6)	4.5 (1-6)	<0.0001
Self-rated health Mean (range)	1.4 (1-3)	1.6 (1-5)	0.0001

Note: T-tests were conducted to assess differences in means for continuous variables; one-way anova tests were conducted to assess differences in proportions for categorical variables.
* Men's and women's mean values/proportions are significantly different at the alpha = 0.01 level
**Men's and women's mean values/proportions are significantly different at the alpha = 0.05 level

Table 3. Bivariate Tobit Regression of Socio-demographic Characteristics, Relationship Quality and Self-rated Health on CES-D score, by sex

	Men	Women
	(n = 542)	(n = 542)
Christian (Muslim)**	-3.33 (0.01)	-3.04 (0.01)
Monogamous (polygynous)	2.06 (<0.0001)	0.27 (0.84)
Relative SES	-1.31 (0.007)	-0.57 (0.09)
Education	0.008 (0.91)	-0.12 (0.19)
Education difference	0.02 (0.70)	0.04 (0.07)
Age	0.04 (0.32)	0.10 (0.04)
Age difference	-0.03 (0.59)	-0.07 (0.46)
Parity	-0.01 (0.79)	0.08 (0.56)
Not pregnant/post-partum	--	0.86 (0.43)
Commitment	0.03 (0.92)	-0.26 (0.13)
Trust	0.13 (0.51)	-0.37 (0.04)
Communication	-0.39 (0.005)	-0.16 (<0.0001)
Satisfaction	-1.11 (0.03)	-2.05 (0.02)
Self-rated Health	-1.30 (0.44)	2.26 (0.045)

Note: All estimates are controlling for clustering by site.

**3 women and 15 men reported their religion as "other", regression includes only those couples who reported their religion as Christian or Muslim.

Table 4.a. Multivariable Tobit Decomposition of Individual/Household Characteristics, Relationship Quality, Self-rated Health and Partner Characteristics on Men's CES-D Scores (n = 542)

	Coefficient (p-value)	Effect on CES-D score for those with a CES-D score > 0	Effect on probability that individuals with CES-D score = 0 will develop depressive symptoms
Individual/Household Characteristics			
Christian (Muslim)	-2.26 (0.07)	-0.78	-20.73%
Monogamous (Polygynous)	-0.26 (0.65)	-0.09	-2.39%
Relative SES	-0.79 (<0.0001)	-0.27	-7.25%
Education	-0.007 (0.93)	-0.002	-0.06%
Education difference	0.11 (0.047)	0.04	0.99%
Age	0.005 (0.94)	0.002	0.04%
Age difference	0.04 (0.63)	0.013	0.3%
Biological children	0.31 (0.002)	0.012	0.3%
Relationship Quality and Self-Rated Health			
Commitment	0.31 (0.002)	0.11	2.88%
Trust	0.13 (0.02)	0.05	1.19%
Communication	-0.30 (0.002)	-0.10	-2.75%
Satisfaction	-1.11 (0.16)	-0.38	-10.20%
Self-rated health	-0.12 (0.62)	-0.04	-1.11%
Partner Characteristics			
Wife's CES-D	0.36 (0.001)	0.13	3.34%
Wife's commitment	0.04 (0.71)	0.013	0.33%
Wife's trust	-0.16 (0.002)	-0.06	-1.50%
Wife's communication	-0.02 (0.76)	-0.006	-0.16%
Wife's satisfaction	-0.51 (0.15)	-0.18	-4.68%

Notes: Religion: 1 = Christian, 2 = Muslim; Marriage type: 1 = polygynous, 2 = monogamous; Relative SES: 1 (poorest) through 9 (wealthiest); Education: continuous years completed; Education difference and age difference: Husband's value – wife's value; Biological children: continuous number; Commitment: possible range from 4 (low) to 36 (high); Trust: possible range from 10 (low) to 35 (high); Communication: possible range from -6 (low) to 27 (high); Satisfaction: possible range from 1 (low) to 6 (high); Self-rated health: 1 (very good) to 5 (very bad). All models reported with robust standard errors to adjust for clustering within study site.

Table 4.b. Multivariable Tobit Decomposition of Individual/Household Characteristics, Relationship Quality, Self-rated Health and Partner Characteristics on Women's CES-D Scores (n = 542)

	Coefficient (p-value)	Effect on CES-D score for those with a CES-D score > 0	Effect on probability that individual with CES-D score = 0 will develop depressive symptoms
Individual/Household Characteristics			
Religion	-2.49 (0.02)	-0.80	-14.47%
Marriage type	-0.39 (0.78)	-0.13	-2.27%
Relative SES	0.18 (0.31)	0.056	1.02%
Education	-0.18 (0.14)	-0.059	-1.06%
Education difference	-0.03 (0.62)	-0.009	-0.16%
Age	0.013 (0.86)	0.004	0.08%
Age difference	-0.07 (0.42)	-0.023	-0.42%
Parity	-0.05 (0.78)	-0.016	-0.29%
Pregnant/post-partum	0.003 (0.99)	0.0009	0.02%
Relationship Quality and Self-Rated Health			
Commitment	-0.03 (0.61)	-0.0009	-0.16%
Trust	-0.11 (0.27)	-0.036	-0.65%
Communication	0.008 (0.92)	0.003	0.05%
Satisfaction	-0.62 (0.47)	-0.20	-3.62%
Self-rated health	1.47 (<0.0001)	0.48	8.56%
Partner Characteristics			
Husband's CES-D	0.61 (0.04)	0.20	3.53%
Husband's Commitment	-0.04 (0.82)	-0.013	-0.23%
Husband's Trust	0.017 (0.78)	0.006	0.10%
Husband's Communication	-0.082 (0.16)	-0.026	-0.48%
Husband's Satisfaction	-0.06 (0.93)	-0.018	-0.32%

Notes: Religion: 1 = Christian, 2 = Muslim; Marriage type: 1 = polygynous, 2 = monogamous; Relative SES: 1 (poorest) through 9 (wealthiest); Education: continuous years completed; Education difference and age difference: Husband's value – wife's value; Parity: continuous number; Commitment: possible range from 4 (low) to 36 (high); Trust: possible range from 10 (low) to 35 (high); Communication: possible range from -6 (low) to 27 (high); Satisfaction: possible range from 1 (low) to 6 (high); Self-rated health: 1 (very good) to 5 (very bad). All models reported with robust standard errors to adjust for clustering within study site.

Table 5. Multivariable Tobit Decomposition of Individual/Household Characteristics, Relationship Quality, Self-rated Health and Partner Characteristics on Men's and Women's CES-D Scores (n = 1084)

	Coefficient (p-value)	Effect on CES-D score for those with a CES-D score > 0	Effect on probability that individuals with CES-D score = 0 will develop depressive symptoms
Individual/Household Characteristics			
Sex	-6.69 (<0.0001)	-2.23	-47.02%
Religion	-2.42 (0.06)	-0.81	-17.01%
Marriage type	-0.43 (0.63)	-0.14	-2.99%
Relative SES	-2.12 (0.002)	-0.70	-14.87%
Education	-0.05 (0.56)	-0.016	-0.35%
Education difference	0.06 (0.001)	0.019	0.39%
Age	0.014 (0.66)	0.005	0.10%
Age difference	-0.01 (0.79)	-0.004	-0.08%
Biological children/parity	0.03 (0.63)	0.01	0.22%
Sex*SES Interaction	1.13 (<0.0001)	0.38	7.97%
Relationship Quality and Self-Rated Health			
Commitment	0.09 (0.03)	0.03	0.65%
Trust	0.08 (0.20)	0.03	0.55%
Communication	-0.12 (<0.0001)	-0.04	-0.83%
Satisfaction	-0.84 (0.13)	-0.28	-5.92%
Self-rated health	-2.09 (0.03)	-0.70	-14.67%
Sex*Self-rated Health Interaction	1.62 (0.01)	0.54	11.40%
Partner Characteristics			
Partner's CES-D	0.48 (0.01)	0.16	3.35%
Partner's Commitment	0.03 (0.88)	0.01	0.20%
Partner's Trust	-0.08 (0.19)	-0.03	-0.54%
Partner's Communication	-0.04 (0.44)	-0.01	-0.26%
Partner's Satisfaction	-0.60 (0.14)	-0.20	-4.23%

Notes: Religion: 1 = Christian, 2 = Muslim; Marriage type: 1 = polygynous, 2 = monogamous; Relative SES: 1 (poorest) through 9 (wealthiest); Education: continuous years completed; Education difference and age difference: Husband's value – wife's value; Biological children/parity: continuous number; Commitment: possible range from 4 (low) to 36 (high); Trust: possible range from 10 (low) to 35 (high); Communication: possible range from -6 (low) to 27 (high); Satisfaction: possible range from 1 (low) to 6 (high); Self-rated health: 1 (very good) to 5 (very bad). All models reported with robust standard errors to adjust for clustering within study site.