RESEARCH ARTICLE

REVISED Determinants of prenatal depression among women attending the antenatal clinic at a referral facility in Mombasa County, Kenya: a case control study [version 2; peer review: 1 approved, 1 approved with reservations]

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Abstract

Background: Despite prenatal depression being a public health burden and the major predictor of postnatal depression, it has not received as much attention as postnatal depression in research and policy globally. There is limited evidence on the factors associated with prenatal depression and therefore understanding these factors will inform the design of specific interventions and formulation of guidelines for the effective prevention and control of prenatal depression particularly in high-risk regions.

Methods: A hospital-based case control study design was used to identify the determinants of prenatal depression among 170 women attending an antenatal clinic. Prenatal depression was assessed using the Edinburgh Postnatal Depression Scale (EPDS). A semi-structured questionnaire was administered to collect data on the socio-demographic, social network and family, lifestyle and obstetric characteristics of the participants. All eligible cases were enrolled into the study while a simple random sample of depression-free women attending the antenatal clinic were enrolled as controls. The relationship between the predictors and prenatal depression was evaluated by logistic regression.

Results: In the multivariable analysis, only marital status (adjusted odds ratio (aOR)=17.1; 95% confidence interval (CI):4.0-73.0), occupation (aOR=2.4; 95% CI:1.4-4.2), domestic violence (aOR=18.3; 95% CI: 5.7-58.7) and social support (aOR=0.2; 95% CI:0.05-0.8) were identified as significant determinants of prenatal depression.

Conclusion: Marital status, occupation, domestic violence and lack of social support were identified as the risk factors for prenatal depression in this setting. To address the burden of prenatal depression in the country, these findings call for inclusion of screening for prenatal depression as an essential component of the routine antenatal care package. We recommend that future studies focus on evaluating specific interventions to address the identified risk factors.

Open Peer Review

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Any reports and responses or comments on the article can be found at the end of the article.

Keywords
Prenatal depression, Edinburgh Postnatal Depression Scale, Determinants, Case control

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REVISED **Amendments from Version 1**

To address the reviewers' comments, in the methodology section, we have clarified that the study site was a county referral hospital. Besides, a description of study procedures, clarification on selection of cases and controls and information on validation of the data collection instruments for the setting have been provided. In the discussion, we have included the possible explanations for the lack of association between age, alcohol, substance abuse and prenatal depression. Since the study was facility-based, the possibility of selection bias has been added as a study limitation in the discussion. In the conclusion section, as recommended, we have indicated opportunities for future research to build on the present study.

Any further responses from the reviewers can be found at the end of the article

Introduction

The prevalence of depression in women is about 20% with pregnancy increasing the susceptibility to depression[1]. Depression related to child bearing can develop either during pregnancy (prenatal depression), after birth (postnatal depression) or both periods (perinatal depression)[2]. Prenatal depression refers to a form of clinical depression which occurs during pregnancy and is characterized by chronic anxiety, insomnia, guilt, fatigue, irritability, forgetfulness, headaches and isolation[3]. The prevalence of prenatal depression in high income countries is between 7%–15% whereas the prevalence in low and middle income countries (LMICs) ranges between 19–25%[4]. In Africa, an 11.3% prevalence of prenatal depression has been reported[5]. Despite prenatal depression being a significant health problem, regrettably, it has received less attention than postpartum depression[6–8]. This is partly attributable to misconceptions about existing socio-cultural structures that could shield one from mental disturbance during this period[6]. Besides, more attention is paid to the physical health of the mother and fetus than on maternal mental health during pregnancy, with a propensity to dismiss emotional episodes as the result of hormonal imbalances. Thus, depression may persist silently during this period[9].

Besides prenatal depression being a major determinant of postnatal depression, it is also a risk factor for adverse maternal and fetal outcomes such as premature births, preterm labor, low birth weight and poor infant feeding patterns[10–12]. Recent studies in Kenya have reported prenatal depression as a predictor for preterm delivery[13] and underweight babies[14]. Moreover, prenatal depression is associated with impaired neurocognitive and socio-developmental disorders in the offspring such as poor motor and regulation skills, anti-social behavior and increased risk of depression and attention problems[15] Additionally, higher health expenses, poor immunization rates and frequent hospitalization have also been reported in children who are born to depressed mothers[16].

Predictors of prenatal depression can be categorized into three domains: social, psychological and biological risk factors. Social risk factors comprise low socio-economic status, lack of social support and stressors such as economic deprivation and unplanned pregnancy[17]. Women from a low socio-economic class are likely to have fewer financial resources which may be insufficient to meet the increasing financial demands of pregnancy and this may result to prenatal depression[16]. Likewise, women who lack social support are likely to have little emotional support from their spouses, family and friends and this can lead to social instability which subsequently leads to prenatal depression[18]. Gestational age, maternal age, genetic and hormonal susceptibility and obstetric complications are some of the biological risk factors for prenatal depression[19]. Women in their first trimester of pregnancy are likely to have higher depression rates than those in the third trimester and this is partly ascribable to the first trimester pregnancy symptoms like fatigue, nausea, food aversions and heartburn, which most women find difficult to cope with[20]. A history of stillbirth or miscarriage can be traumatic and may result in anxiety or depression[18,21,22]. The main psychological predictor of prenatal depression is a history of mental disorders[23]. Other predictors of prenatal depression in the Kenyan setting include adolescent pregnancy[24] and mother's HIV status[25].

In Kenya, there are very few published research studies that have explored the factors associated with prenatal depression[13]. Given this paucity of research on prenatal depression in Kenya there is need to understand the predictors of prenatal depression with a view to informing the design of specific interventions and formulation of guidelines for the effective prevention, control and surveillance of prenatal depression particularly in high-risk regions in Kenya. Consequently, the objective of this study was to investigate the sociodemographic, lifestyle, obstetric and social network and family determinants of prenatal depression among women attending the antenatal clinic (ANC) at a referral facility in Mombasa County, Kenya.

Methods

Study design and setting

A hospital-based case control study design was used to identify the determinants of prenatal depression. The choice of study design owes to its suitability in the investigation of rare outcomes that may be missed through random sampling. Although a population-based study would have been more optimal, a hospital-based design was selected due to the ease of recruitment of pregnant mothers (cases and controls) presenting to the antenatal clinic for care.

The study was conducted at the Coast Provincial General Hospital (CPGH) which is a county referral public facility located in Mombasa County, Kenya. The facility's total catchment population is roughly four million people and includes the neighboring Coastal counties[26]. The antenatal clinic offers routine ANC services and the clinic visits are scheduled monthly with the average number of clinic visits per pregnant woman being four. The number of first-time antenatal visits per month is on average 140. Notably, prenatal depression is not screened for during ANC visits.

Study population and eligibility of participants

The study population comprised pregnant women ≥15 years attending routine ANC at CPGH during the data collection period between April and June 2019. All pregnant women who consented to participate were recruited to the study. Women who had already been diagnosed with depression prior to pregnancy or had concurrent chronic illnesses were excluded from the study.

Study procedures and outcome assessment

Recruitment and interview of participants was carried out by two hospital-based research assistants (registered nurses) who had previously been trained on interviewing techniques. Upon obtaining informed consent from the subjects, the Edinburgh Postnatal Depression Scale (EPDS) (either the English or Kiswahili version depending on the individual's preference)[27,28] was administered via a face-to-face interview in a private room within the ANC clinic. The EPDS tool was completed just before provision of routine ANC services.

Case definition and recruitment

A case was a pregnant woman aged ≥15 years residing in the hospital's catchment area who had been attending the ANC clinic at CPGH during the two-month study period and registered an EPDS score of ≥13[29]. All cases meeting this definition were prospectively recruited into the study until the required total was realized (see sample size determination).

Control definition and recruitment

Controls were pregnant women similarly defined as cases but with EPDS scores of <13[27] presenting to the same ANC clinic for care. Owing to the comparably large number of controls, these were simple randomly sampled and frequency-matched to cases by day of presentation.

Sample size determination

The appropriate sample size was estimated as per Kelsey *et al.*[30] for case control studies:

$$n_1 = \frac{(Z_\alpha + Z_\beta)^2 \bar{p}\bar{q}(r+1)}{r(p_1 + p_2)^2}$$

$$n_2 = rn1$$

$$p_1 = \text{proportion of cases exposed} = \frac{p_2 \text{OR}}{1 + p_2(\text{OR} - 1)}$$

$$\bar{p} = \frac{p_1 + rp_2}{r+1}$$

$$\bar{q} = 1 - \bar{p}$$

Whereby:

n_1 = number of cases and n_2 = number of controls. p_1 = proportion of cases with previous history of intimate partner violence (IPV) or domestic violence (primary exposure) and p_2 = proportion of controls with previous history of IPV (set at 0.40)[31]. Of note, $Z_{\alpha/2}$ (1.96) is the value for a two-tailed 95% confidence level and $Z_{1-\beta}$ (-0.84) is the value for a statistical power of 80%. The odds ratio for the IPV-prenatal depression association was hypothesized to be 3[31]. To enhance statistical power, a ratio of four controls per case was employed. Based on these estimates, a total sample size of 34 cases and 136 controls was derived.

Study variables and method of measurement

Information on predictor variables was collected from the case and control participants using a semi-structured questionnaire (administered in a similar manner as the EPDS tool) (see *Extended data*)[32] and included demographic characteristics, lifestyle, social network and family risk factors and obstetrical factors. The demographic predictors included age, level of education, occupation and marital status. Social network and family related predictors consisted of social support and domestic violence. Lifestyle factors comprised smoking, use of alcohol and substance abuse. Obstetric factors were unplanned pregnancy, gestational age, history of still birth, history of miscarriage/pregnancy loss and parity. Table 1 shows the method of assessment of the study variables. Figure 1 displays the relationship between the predictor variables and outcome.

Ethical considerations

Approval to conduct the study was obtained from the Kenyatta National Hospital-University of Nairobi (KNH-UON) Ethics and Research Committee (P787/11/2018). Written informed consent was secured from the participants prior to engaging in the study.

Minimization of errors and bias

Following data collection, the questionnaires were manually checked for completeness and accuracy. Data were then double entered by two data entry clerks into an Excel Spreadsheet, after which the resulting datasets were compared and revisions made accordingly. Interviewer bias was minimized by training the research assistants on the standard operating procedures (SOPs) to ensure consistency in elicitation of information from the respondents. In a bid to minimize recall bias information such as the gestational age, the obstetric history and number of antenatal clinic visits was abstracted from the mother and child health booklet.

Statistical analysis

The Excel dataset was exported to Stata version 13.0 (Stata Corporation, College Station, Texas, USA) for analysis.

Descriptive statistics (medians, means, standard deviations and inter-quartile ranges) were used to summarize continuous variables. Proportions and percentages were generated for categorical variables. In the univariable analysis, the effect of each predictor on the odds of prenatal depression was assessed

Table 1. Study variables and their assessment.

Variable (type)	Method of assessment
Prenatal depression (nominal)	Denoted in binary form: Present or absent. This was assessed using the Edinburgh Postnatal Depression Scale which is a 10-item questionnaire which scores women's feelings and experiences of the last one week on a likert scale. The recommended cut offs for the English and Swahili version is ≥13. The sensitivity and specificity of EPDS in the African setting has been shown to be 94% and 77% respectively[27]. The EPDS scale has shown to be the most reliable instrument used for screening of antenatal depression in resource constrained settings because of the reported specificity, sensitivity and reliability[33]. Furthermore, the EPDS has been validated for use in Kenya[34]. A score of ≥13 denoted presence of prenatal depression while a score of <13 denoted absence of prenatal depression
Age (continuous)	Captured in years
Level of education (ordinal)	The level of education attained by the pregnant women attending ANC. Categorized into three levels: 1= Primary school, 2= secondary school and 3=tertiary level
Occupation (nominal)	Assessed in two levels: Employed or Unemployed
Tobacco use (ordinal)	Through smoking or chewing and it was graded into 3 groups: Non user, rare user or regular user[35]
Alcohol intake (ordinal)	Graded into 3 categories: Non user, rare user or regular user[35]
Substance abuse (ordinal)	Cannabis, cocaine, heroin, valium, rohypnol, muguka, miraa, codeine and glue were assessed under substance abuse. Graded into 3 groups: Non user, rare user or regular user[35]
Current gestational age (continuous)	Abstracted from the ANC booklet based on the LMP. This was captured in weeks
Parity (nominal)	Abstracted from the ANC booklet. This was captured as either primiparous or multiparous
Unplanned pregnancy (nominal)	This was captured as either planned or unplanned
Obstetric complications (nominal)	Comprised a history of either of the following: abortion, miscarriage, still birth, premature birth or fistula. They were assessed as either being present or absent.
Social support (ordinal)	This was assessed using the English version of the Social Provisions Scale (SPS-10)[36]. The SPS-10 is a reliable and valid measure of social support with an overall Cronbach's alpha of 0.92[36] and it has been used to assess social support in LMICs as well as in pregnant women populations[37]. Captured as 0=Lack of social support, 1=Presence of social support
Domestic violence (ordinal)	It was assessed through the English version of the Composite Abuse Scale (CAS_R-SF) which is a description of actions that women report as abusive by their spouses. The composite abuse scale has been validated in the assessment of IPV and is the recommended IPV assessment tool by Centers for Disease Control and Prevention[38]. It has been used in Kenyan studies and has demonstrated high validity with a Cronbach's alpha of 0.917[39]. This was categorized as 0 = no lifetime experience of abuse and 1 = lifetime experience of abuse present[40]

using logistic regression at a liberal P-value (P≤0.20)[41]. Since inclusion of age as a continuous variable was insignificant in the univariable analysis, it was categorized into three groups: 18–25 years, 26–29 years and 30–44 years and reassessed for significance as a categorical variable.

Variables that were found to be significant in the univariable analysis were offered to a multivariable model, where a backward step-wise approach was used to eliminate variables from the model at P>0.05. Notably, the non-significant variables were eliminated from the model if their exclusion from the model did not result in a greater than 30% change in the effects of the remaining variables[41]. Two-way interactions were fitted between the remaining variables in the final model and their significance assessed. A Hosmer-Lemeshow test was used to assess the goodness of fit of the logistic model, with a P-value of > 0.05 being suggestive of a good fit.

Results

Descriptive statistics of the study data

A total of 170 pregnant women (34 cases, 136 controls) were enrolled into the study.

A study flow chart illustrating the enrollment process is shown in Figure 2. Table 2 shows the descriptive statistics of the respondents.

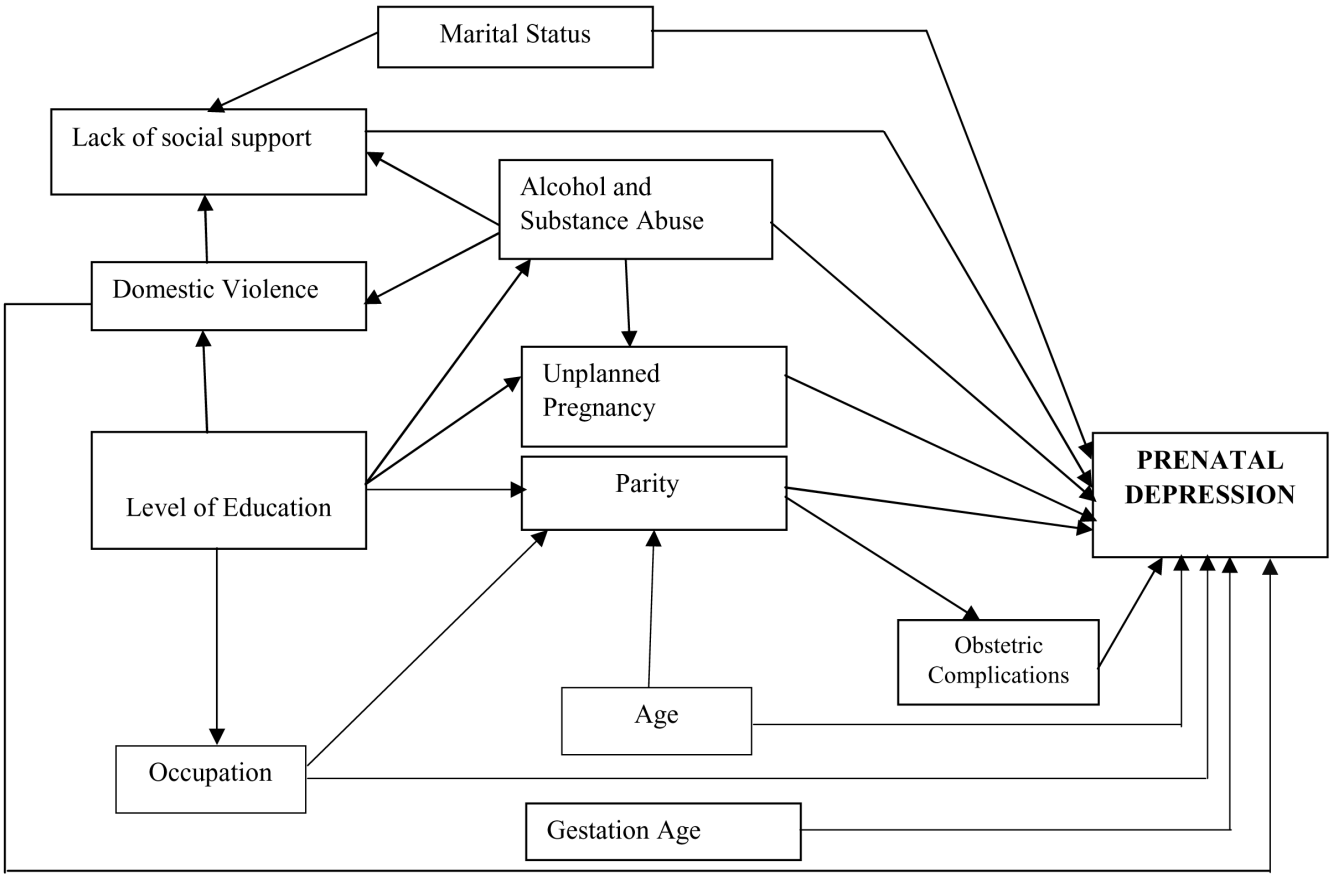

Figure 1. Causal diagram of factors thought to influence prenatal depression among women attending the antenatal clinic at the Coast Provincial General Hospital, Mombasa County, Kenya.

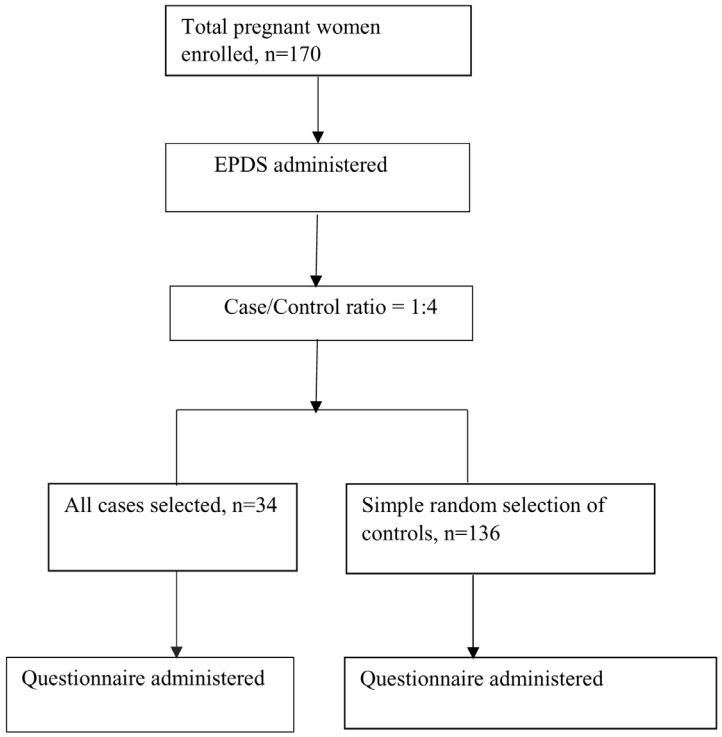

Figure 2. Study flow chart.

Table 2. Descriptive statistics of women attending the antenatal clinic at the Coast Provincial General Hospital, Mombasa County, Kenya (N=170).

Variable	Category	All pregnant women (N=170), n (%)	Cases (N=34), n (%)	Controls (N=136), n (%)
Age (years)	18–25	59 (34.7)	10 (29.4)	49 (36.0)
	26–29	55 (32.4)	17 (50.0)	38 (27.9)
	30–44	56 (32.9)	7 (20.6)	49 (36.0)
Mean	-	27.8	27.0	28.0
Range	-	18–44	19–36	18–44
Marital status	Married	150 (88.2)	23 (67.7)	127 (93.4)
	Single	20 (11.8)	11 (32.3)	9 (6.6)
Level of education	Tertiary	75 (44.1)	17 (50.0)	58 (42.7)
	Secondary	63 (37.1)	9 (26.5)	54 (39.7)
	Primary	32 (18.8)	8 (23.5)	24 (17.6)
Occupation	Employed	77 (45.3)	9 (26.5)	68 (50.0)
	Unemployed	93 (54.7)	25 (73.5)	68 (50.0)
Alcohol and drug use	User	25 (14.7)	10 (29.4)	15 (11.0)
	Non-user	145 (85.3)	24 (70.6)	121 (89.0)
Gestational age	2nd trimester	56 (32.9)	15 (44.1)	41 (30.1)
	3rd trimester	114 (67.1)	19 (55.9)	95 (69.9)
Mean	-	28.3	26.8	28.8
Range	-	13–38	20–38	13–38
Parity	Primiparous	67 (39.4)	13 (38.2)	54 (39.7)
	Multiparous	103 (60.6)	21 (61.8)	82 (60.3)
Unplanned pregnancy	Yes	34 (20)	13 (38.2)	21 (15.4)
	No	136 (80.0)	21 (61.8)	115 (84.6)
Obstetric complications	Yes	32 (18.8)	9 (26.5)	23 (16.9)
	No	138 (81.2)	25 (73.5)	113 (83.1)
Social support	Yes	150 (88.2)	21 (61.8)	129 (94.9)
	No	20 (11.8)	13 (38.2)	7 (5.1)
Domestic violence experience	Yes	47 (27.6)	22 (64.7)	25 (18.4)
	No	123 (72.4)	12 (35.3)	111 (81.6)
Prenatal depression	No	136 (80.0)	0 (0.0)	136 (100.0)
	Yes	34 (20.0)	34 (100.0)	0 (0.0)

Socio-demographic factors

The mean age of the respondents was 27.8 years (range: 18–44 years) with the mean age of cases being 27.0 years (range: 19–36 years) and that of controls being 28.0 years (range: 18–44 years). On the level of education, 44.1% (n=75) of the respondents had attained a tertiary level of education; this comprised 50.0% (n=17) of the cases and 42.7% (n=58) of the controls. Only 45.3% (n=77) of the respondents were employed, of which 26.5% (n=9) were cases and 50% (n=68) were controls.

Lifestyle factors

Respondents who reported to have consumed alcohol, tobacco or abused substances during the pregnancy period constituted 14.7% (n=25) of the population. Amongst these 29.4% (n=10) were cases and 11% (n=15) were controls.

Obstetric factors

A fifth (20%, n=34) of the respondents reported that the current pregnancy was unplanned. Of these, 38.2% (n=13) were

cases while 15.4% (n=21) were controls. Approximately 19% (18.8%, n=32) of the participants reported to have experienced obstetric complications in previous pregnancies. Of these, 26.5% (n=9) were cases and 16.9% (n=23) were controls.

Social network and family factors

Majority of the participants had received social support (88.2%, n=150). In particular, 61.8% (n=21) of the cases reported to have had social support compared to 94.9% (n=129) of the controls. The proportion of women who experienced domestic violence was 27.6% (n=47), with this proportion being higher among cases at 64.7% (n=22) than in controls at 18.4% (n=25).

Results of regression analyses

Of the factors assessed, only age, marital status, occupation, alcohol and substance abuse, unplanned pregnancy, gestational age, social support and domestic violence were associated with prenatal depression at P≤0.2. (Table 3). These variables were subsequently included in the multivariable model. In the multivariable analysis, only marital status, occupation, social support and domestic violence were shown to be significant predictors of prenatal depression at 5% significance level (Table 4). Exclusion of the non-significant variables from the model did not result in ≥30% change in the effects of the remaining variables.

Compared to participants who were married, those who were single had 17.1 times the odds (adjusted odds ratio (aOR)=17.1; 95% confidence interval (CI): 4.0-73.0) of prenatal depression controlling for their occupation, domestic violence and social support status. Unemployed respondents had 2.4 times the odds of prenatal depression (aOR=2.4; 95% CI: 1.4-4.2) as employed participants holding their marital status, domestic violence experience and social support constant. Participants who experienced domestic violence had 18.3 times the odds of prenatal depression (aOR=18.3; 95% CI: 5.7-58.7) compared to those who did not experience domestic violence regardless of their marital status, occupation and social support level. Respondents who had social support had one-fifth the odds of prenatal depression (aOR=0.2; 95% CI: 0.05-0.8) in comparison to those who did not have social support controlling for their marital status, occupation and domestic violence experience.

The model had a good fit (P = 0.403).

Table 3. Univariable analysis of factors associated with prenatal depression among women attending the antenatal clinic at Coast Provincial General Hospital, Mombasa County, Kenya (N=170).

Variable	Value	Odds ratio	95% CI	P-Value
Age*	18–25	Ref		0.045
	26–29	2.2	0.9–5.3	
	30–44	0.7	0.3–1.9	
Education	Primary	Ref		0.335
	Secondary	0.5	0.2–1.5	
	Tertiary	0.9	0.3–2.3	
Marital status*	Married	Ref		<0.001
	Single	6.7	2.5–18.1	
Occupation*	Employed	Ref		0.012
	Unemployed	1.7	1.1–2.5	
Alcohol and drug use*	Non-user	Ref		0.012
	User	3.4	1.3–8.4	
Gestational age*	3rd trimester	Ref		0.124
	2nd trimester	1.8	0.8–3.9	
Parity	Primiparous	Ref		0.875
	Multiparous	1.1	0.5–2.3	
Unplanned pregnancy*	No	Ref		0.004
	Yes	3.4	1.5–7.8	
Obstetric complications	No	Ref		0.228
	Yes	1.4	0.8–2.3	
Social support*	No	Ref		<0.001
	Yes	0.08	0.03–0.2	
Domestic violence*	No	Ref		<0.001
	Yes	8.1	3.5–18.6	

*Variables eligible for inclusion in the multivariable model (P≤0.20). CI, confidence interval.

Discussion

Marital status was shown to be a significant predictor of prenatal depression among women in the study with single women having higher odds of prenatal depression compared to those who were married. This finding is corroborated by other studies[21,42]. Being single as a result of a break up or abandonment by a partner can result in emotional problems and lack of social support from the male partners and this could lead to depression. Moreover, single parenting is stigmatized in the African culture and this may predispose one to antenatal depression[43].

This study found that unemployed women had higher odds of prenatal depression compared to their employed counterparts. This finding is similar to that reported by a study in Italy[44] which found that participants who were unemployed had 2.17 times the odds of prenatal depression compared to those who were employed. Another study conducted among Japanese women revealed that employment is protective against prenatal depression[45]. Pregnant women who are unemployed have fewer financial resources which may be insufficient to meet the increasing demands of pregnancy and this may predispose to prenatal depression.

Domestic violence was strongly associated with prenatal depression in this study. These findings are consistent with those from other studies, which described gender-based violence

Table 4. Multivariable analysis of factors associated with prenatal depression among women attending antenatal clinic in Coast Provincial General Hospital, Mombasa County, Kenya (N=170).

Variables	Values	aOR	95% CI	P value
Marital status	Married	Ref		<0.001
	Single	17.1	4.0–73.0	
Occupation	Employed	Ref		0.002
	Unemployed	2.4	1.4–4.2	
Domestic violence	No	Ref		<0.001
	Yes	18.3	5.7–58.7	
Social support	No	Ref		0.020
	Yes	0.2	0.05–0.8	

aOR, adjusted odds ratio; CI, confidence interval.

as an important predictor of prenatal depression with women who experience psychological, physical and sexual violence being prone to antenatal depression[46–48]. Domestic violence may cause physical injury with attendant emotional and psychological trauma that can lead to depression[49].

Social support was protective against prenatal depression in this study. These findings support the results of other studies[18,43,50–52]. Social support from a spouse, friends or relatives provides psychosocial resources during pregnancy and these act as a cushion against difficulties that may be experienced during pregnancy hence can protect one from antenatal depression. In contrast, women who lack social support are likely to have little emotional support from their spouses, family and friends bringing about social instability which can heighten the risk of prenatal depression[53,54].

Age did not significantly influence the likelihood of prenatal depression in this study. This could partly be explained by the presence of the stronger risk factors (marital status, occupation, domestic violence and social support) for prenatal depression than age in the multivariable model. However, other studies have revealed that age is a significant predictor of prenatal depression owing to the fact that young pregnant women are likely to be financially unstable and may not be socially and psychologically prepared to cope with pregnancy demands and this may predispose them to depression[55]. Contrarily, some studies have demonstrated that older women are at a higher risk of developing prenatal depression as ageing increases the possibility of experiencing difficulties in conceiving and anxiety of experiencing obstetric complications. Besides, there is a high likelihood of experiencing stigma when you conceive later in life[56,57].

Use of alcohol and abuse of drugs did not significantly predict a participant's probability of developing prenatal depression taking into account the effect of other variables. This finding could possibly be due to the fact that, per the causal diagram, the relationship between substance abuse and prenatal depression is partly mediated through domestic violence and social support so that when they are adjusted for in the presence of substance abuse, the relationship is substantially weakened. The findings of this study concur with the results of a study conducted among African American women[58]. On the contrary, other studies have reported a significant relationship between alcohol and drug abuse and prenatal depression[42,59,60]. Alcohol being a depressant may inhibit neurotransmitters that regulate mood such as serotonin and norepinephrine, and this can lead to depression[61].

After accounting for other variables, unplanned pregnancy was not found to be significantly related to developing prenatal depression in this study. This is partly ascribable to the fact that although an unplanned pregnancy might be unwanted at first, as the pregnancy progresses the shock associated with the undesired occurrence decreases and it becomes increasingly accepted, hence reducing the symptoms of depression[62]. Other studies have reported a significant association between unplanned pregnancy and prenatal depression which is related to the fact that unplanned pregnancy is associated with lack of preparedness to deal with the financial and psychological demands of pregnancy[46,63,64].

Gestational age was not found to be associated with prenatal depression after controlling for other variables. This finding is similar to another study that was conducted in KwaZulu-Natal[65]. Nonetheless, other studies have demonstrated that women who are in the second or third trimester are less likely to be depressed antenatally compared to women in the first trimester owing to the fact that during the first trimester some women find it difficult to cope with pregnancy symptoms like nausea and food aversions and this can lead to depression[9,42,66]. The results from this study are generalizable to populations of pregnant women presenting for ANC services in similar LMIC settings.

A couple of limitations are present in this study. There was likely to be differential recall of past exposures between cases and controls with cases having better recall than controls. Moreover, cases were more likely to over-report their exposures and this could bias the effect estimates away from unity. The case definition of prenatal depression only relied on EPDS, which is a screening tool; this could have been supplemented by a clinical examination of the participants to improve on detection of prenatal depression. Moreover, considering the facility-based nature of the study, the results are likely to suffer selection bias since it is probable that depressed women would be less inclined to present themselves for antenatal care. This is likely to have biased the effect estimates towards unity.

Conclusions

The present study showed that marital status, occupation, domestic violence and lack of social support were the predictors of prenatal depression in this setting. To address the burden of prenatal depression in the country, we advocate for the inclusion of screening for prenatal depression as an essential component of the antenatal care package. We recommend that future research focuses on evaluating specific interventions to address the identified predictors of prenatal depression.

Data availability

Underlying data

Harvard Dataverse: prenatal depression CPGH. https://doi.org/10.7910/DVN/QIFMOT.

This project contains the following underlying data:

- Prenatal depression_data.xlsx (containing responses to each question of the questionnaire from all participants).

Extended data

Harvard Dataverse: prenatal depression CPGH. https://doi.org/10.7910/DVN/QIFMOT.

This project contains the following extended data:

- Prenatal depression_questionnaire.pdf (questionnaire used in this study).
- prenatal_depression_code.do (STATA commands file for determinants of prenatal depression evaluation).

Acknowledgements

The authors are grateful to the study participants and staff members of the Coast Provincial General Hospital antenatal clinic for their support throughout the data collection process and their contribution to the success of this study. We also wish to express our appreciation to the Coast Provincial General Hospital administration for authorizing use of the facility for the study.

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Open Peer Review

Current Peer Review Status: ✔ ?

Version 2

Reviewer Report 21 May 2020

https://doi.org/10.5256/f1000research.26336.r63424

✔ **Linnet Ongeri**
Centre for Clinical Research, Kenya Medical Research Institute (KEMRI), Nairobi, Kenya

The authors have addressed all comments raised.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I am a psychiatrist and mental health researcher. I have published papers on perinatal depression

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 01 April 2020

https://doi.org/10.5256/f1000research.24279.r59454

? **Abiodun O. Adewuya**
Department of Behavioral Medicine, Lagos State University College of Medicine, Ikeja, Nigeria

This study addresses an important topic as depression during the perinatal period is every common and have adverse impact on the women, the child and the entire family especially in LMICs. However, I have

many reservations about the justification, the study design, the data collection and analysis

Introduction

- There is need to show that a review of the literature from SSA has been carried out and the gap in the knowledge had been identified which this present work is trying to fill. See below a list of published works I could find:

- Green EP, Tuli H, Kwobah E, Menya D, Chesire I, Schmidt C. Developing and validating a perinatal depression screening tool in Kenya blending Western criteria with local idioms: A mixed methods study. Journal of affective disorders. 2018 Mar 1;228:49-59[1].

- Ongeri L, Otieno P, Mbui J, Juma E, Mathai M. Antepartum risk factors for postpartum depression: a follow up study among urban women living in Nairobi, Kenya. J Preg Child Health. 2016;3(288):2[2].

- Osok J, Kigamwa P, Vander Stoep A, Huang KY, Kumar M. Depression and its psychosocial risk factors in pregnant Kenyan adolescents: a cross-sectional study in a community health Centre of Nairobi. BMC psychiatry. 2018 Dec;18(1):136[3].

- Osok J, Kigamwa P, Huang KY, Grote N, Kumar M. Adversities and mental health needs of pregnant adolescents in Kenya: identifying interpersonal, practical, and cultural barriers to care. BMC women's health. 2018 Dec 1;18(1):96[4].

- Velloza J, Njoroge J, Ngure K, Thuo N, Kiptinness C, Momanyi R, Ayub S, Gakuo S, Mugo N, Simoni J, Heffron R. Cognitive testing of the PHQ-9 for depression screening among pregnant and postpartum women in Kenya. BMC psychiatry. 2020 Dec 1;20(1):31[5].

Methods

- The authors described the Coast Provincial General Hospital (CPGH) as a “level five” public health facility located in Mombasa County, Kenya. They need to describe what this means to the reading public. The authors also need to explain why the choice of a referral hospital where only the complicated cases (needing doctors attention) are referred. It is expected that majority of the deliveries in Kenya will be via the primary health facilities with attending midwives. The choice of a level 5 facility will definitely bias the outcome

- The procedure did not state how the EPDS was administered. Was it self administered or interviewer administered? What of non-literate women, how were they catered for? Also how valid is the EPDS amongst Kenyan women population? It should be noted that a rate of 20% positive (34/170) was obtained in this study.

- Sample size: A detailed sample size formulae was provided but not how the sample size of 34 cases in the index arm was obtained. This number I think is definitely too low and do not have enough power to make any prediction for a data that is focused on determinants and significantly associated factors in a population

- Study design: It was not clear how the participants were selected into cases and control. Given that the authors said the EPDS was completed in the triage room before the routine antenatal services, were the individual scores collated there and then before asking them to complete the rest of the questionnaire or did they all completed the questionnaire no matter what they score? There is a concern that the design of this study may not follow the case-control design

Results

- Why was P≤0.2 chosen as the level of significance during the univariate analysis?

- The very wide Confidence interval in Table 4 again gives cause for concern regarding the sample size and the power of the study

References

1. Green E, Tuli H, Kwobah E, Menya D, et al.: Developing and validating a perinatal depression screening tool in Kenya blending Western criteria with local idioms: A mixed methods study. *Journal of Affective Disorders*. 2018; **228**: 49-59 Publisher Full Text
2. Ongeri L, Otieno P, Mbui J, Juma E, et al.: Antepartum Risk Factors for Postpartum Depression: A Follow up Study among Urban Women Living in Nairobi, Kenya. *Journal of Pregnancy and Child Health*. 2016; **03** (05). Publisher Full Text
3. Osok J, Kigamwa P, Stoep A, Huang K, et al.: Depression and its psychosocial risk factors in pregnant Kenyan adolescents: a cross-sectional study in a community health Centre of Nairobi. *BMC Psychiatry*. 2018; **18** (1). Publisher Full Text
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5. Velloza J, Njoroge J, Ngure K, Thuo N, et al.: Cognitive testing of the PHQ-9 for depression screening among pregnant and postpartum women in Kenya.*BMC Psychiatry*. 2020; **20** (1): 31 PubMed Abstract | Publisher Full Text

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public Mental Health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 03 May 2020

Harriet Mirieri, University of nairobi, Nairobi, Kenya

Introduction

1. There is need to show that a review of the literature from SSA has been carried out and the gap in the knowledge had been identified which this present work is trying to fill.

As indicated in the manuscript, review of literature revealed that there is paucity of research on prenatal depression in Kenya and this study aimed at contributing towards filling this gap by understanding the predictors of prenatal depression and informing the formulation of guidelines for effective prevention and control of prenatal depression.

Methods

2. The authors described the Coast Provincial General Hospital (CPGH) as a “level five” public health facility located in Mombasa County, Kenya. They need to describe what this means to the reading public. The authors also need to explain why the choice of a referral hospital where only the complicated cases (needing doctors attention) are referred. It is expected that majority of the deliveries in Kenya will be via the primary health facilities with attending midwives. The choice of a level 5 facility will definitely bias the outcome

Although the CPGH is a referral facility, the ANC clinic also attends to mothers seeking routine antenatal care and is actually the main county facility offering ANC services.

3. The procedure did not state how the EPDS was administered. Was it self administered or interviewer administered? What of non-literate women, how were they catered for? Also how valid is the EPDS amongst Kenyan women population? It should be noted that a rate of 20% positive (34/170) was obtained in this study.

As modified in the manuscript, the data collection tools were administered by the research assistants in a face to face interview. Besides, the EPDS has been validated to be used in the Kenyan setting. Given that this was a case control study, we did not give a disease frequency measure since we do not have all the cases present for the study.

4. Sample size: A detailed sample size formulae was provided but not how the sample size of 34 cases in the index arm was obtained. This number I think is definitely too low and do not have enough power to make any prediction for a data that is focused on determinants and significantly associated factors in a population

Given a 95% confidence level, 80% statistical power, odds ratio of 3 for the main exposure-outcome association (domestic violence – prenatal depression) and 40% proportion of controls (non-depressed women) that are exposed (have experience domestic violence) and a ratio of 4:1 for controls to cases (in order to optimize on statistical power) we get a sample size of 170. This is anticipated in case control studies considering that they target outcomes with low frequency in the population.

5. Study design: It was not clear how the participants were selected into cases and control. Given that the authors said the EPDS was completed in the triage room before the routine antenatal services, were the individual scores collated there and then before asking them to complete the rest of the questionnaire or did they all completed the questionnaire no matter what they score? There is a concern that the design of this study may not follow the case-control design

In addition to the modification included in the manuscript taken together with the study flow chart, we further provide a clarification here. The EPDS was initially applied (by face-to-face interview) in a private room to identify cases and controls based on cut-off point of 13 (considering that prenatal depression is not routinely screened for). Afterwards, the cases and controls were interviewed to elicit information on the study predictors.

Results

6. Why was P≤0.2 chosen as the level of significance during the univariate analysis?

A liberal p-value of ≤ 0.20 is commonly used to allow variables that are potentially negatively confounded during the univariable analysis stage (effect has been suppressed by other study variables) to "express" themselves in the multivariable analysis once the effect of the suppressing variables has been removed – See Dohoo et al. 2012.

7. The very wide Confidence interval in Table 4 again gives cause for concern regarding the sample size and the power of the study

We believe that the wide confidence intervals for some of the variables (marital status and domestic violence) is more of a reflection of collinearity than sample size. For instance, with marital status and domestic violence being highly correlated, the standard errors of these variables is likely to be elevated and thus their confidence intervals.

Competing Interests: No competing interests were disclosed.

Reviewer Report 13 March 2020

https://doi.org/10.5256/f1000research.24279.r60464

?

Linnet Ongeri
Centre for Clinical Research, Kenya Medical Research Institute (KEMRI), Nairobi, Kenya

This is a well written manuscript. However, I have a few comments that may help strengthen the manuscript.

1. In the introduction, the authors state that Depression related to child bearing can develop either during pregnancy (prenatal depression), after birth (postnatal depression) or both (perinatal depression)". The word both is hanging, consider both periods.

2. Still in the introduction, the authors state: The main psychological and psychiatric predictors of prenatal depression are history of mental or anxiety disorder". This is confusing, since anxiety disorder is a mental disorder. Consider correcting to read: The main psychological predictor of prenatal depression is a history of mental disorders.

3. In the methods, the study lacks a description of study procedures, specifically: Were the questions administered through interviews, or self reporting? Were the tools translated, what language was used, who administered the tools, where was this done in the hospital, a private room perhaps?

4. In the methods, kindly clarify if the social provisions scale and the composite abuse scale were translated and validated for the setting. Have they been used in this setting?

5. Under statistical analysis, the authors describe the categorization of ages "Since inclusion of age as a continuous variable was insignificant in the univariable analysis, it was categorized into three groups: 18–25 years, 26–29 years and 30–34 years and reassessed for significance as a categorical variable." What informed this categorization and where were the women older than 34 years included?

6. In the discussion: the authors state "Age did not significantly influence the likelihood of prenatal depression in this study. However, other studies have revealed that age is a significant predictor of prenatal depression owing to the fact that young pregnant women are likely to be financially unstable and may not be socially and psychologically prepared to cope with pregnancy demands and this may predispose them to depression". The authors may need to elaborate or postulate why this study found no association with age, seeing that other studies have found some link. What is a possible explanation. Perhaps the age range of your sample was not wide enough? Similarly to alcohol and substance use, kindly give an explanation for the negative findings.

7. Under limitations the authors state "The results from this study are generalizable to similar settings in other low- and middle-income countries." I believe the authors meant not generalizable. Please correct.

8. Also include limitation that this study was a facility based study as opposed to population based. We know majority of depressed ladies may not go for antenatal care, hence some bias in sample selection.

9. The conclusion can be considered an over reach. It appears as if the authors did an intervention study that identified these specific interventions to work while instead they have simply identified risk factors in a small non generalized population. I believe the conclusion should call for more research around specific risk factors identified (violence and social support and how it relates to prenatal depression). This study goal was not to screen nor examine the interventions postulated in the conclusion but to identify predictors/risk factors. Also results were not generalizable. Consider including future studies on the same for a larger more generalizable studies with these predictors included or more studies that replicate similar findings to establish these predictors. Perhaps also test interventions that can address this predictors.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I am a psychiatrist and mental health researcher. I have published papers on perinatal depression

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 03 May 2020

Harriet Mirieri, University of nairobi, Nairobi, Kenya

1. In the introduction, the authors state that Depression related to child bearing can develop either during pregnancy (prenatal depression), after birth (postnatal depression) or both (perinatal depression)". The word both is hanging, consider both periods

The word 'periods' has been added to the statement on types of depression during childbirth as recommended

2. Still in the introduction, the authors state: The main psychological and psychiatric predictors of prenatal depression are history of mental or anxiety disorder". This is confusing, since anxiety disorder is a mental disorder. Consider correcting to read: The main psychological predictor of prenatal depression is a history of mental disorders

The statement 'The main psychological predictor of prenatal depression is a history of mental disorders ' has been added to the manuscript

3. In the methods, the study lacks a description of study procedures, specifically: Were the questions administered through interviews, or self-reporting? Were the tools translated, what

language was used, who administered the tools, where was this done in the hospital, a private room perhaps?

In addition to the modification included in the manuscript, recruitment and interview of participants was carried out by two hospital-based research assistants (registered nurses). Upon obtaining informed consent from the participants, the Edinburgh Postnatal Depression Scale (EPDS) (either the English or Kiswahili version depending on the individual's preference) was administered via a face-to-face interview in a private room within the ANC clinic. Information on predictor variables was collected from the case and control participants using a semi-structured questionnaire (administered in a similar manner as the EPDS tool)

4. In the methods, kindly clarify if the social provisions scale and the composite abuse scale were translated and validated for the setting. Have they been used in this setting?

As modified in the manuscript, the English version of the social provisions scale and composite abuse scale were used and both have been validated to be used in this setting.

5. Under statistical analysis, the authors describe the categorization of ages "Since inclusion of age as a continuous variable was insignificant in the univariable analysis, it was categorized into three groups: 18–25 years, 26–29 years and 30–34 years and reassessed for significance as a categorical variable." What informed this categorization and where were the women older than 34 years included?

Inclusion of age as a continuous variable assumes that age is linearly associated with the log odds of prenatal depression. If this assessment is insignificant, categorization of age allows the exploration of a potential non-linear association.

6. In the discussion: the authors state "Age did not significantly influence the likelihood of prenatal depression in this study. However, other studies have revealed that age is a significant predictor of prenatal depression owing to the fact that young pregnant women are likely to be financially unstable and may not be socially and psychologically prepared to cope with pregnancy demands and this may predispose them to depression". The authors may need to elaborate or postulate why this study found no association with age, seeing that other studies have found some link. What is a possible explanation? Perhaps the age range of your sample was not wide enough? Similarly, to alcohol and substance use, kindly give an explanation for the negative findings.

We believe that the lack of association between 'age' and 'alcohol and substance abuse' and prenatal depression can be explained statistically. The effects of these two variables are clearly distorted (mixed-up) with the effects of the more stronger predictors (marital status, occupation, domestic violence and social support) so that upon the removal of the effects (control of confounding) of these latter predictors in the multivariable analysis, age' and 'alcohol and substance abuse' cease to important predictors. Thus, for instance, revealing that a woman's marital status, employment status, whether or not she's violated or has social support is more telling of her depression status than simply her age.

7. Under limitations the authors state "The results from this study are generalizable to similar settings in other low- and middle-income countries." I believe the authors meant not generalizable. Please correct.

We inadvertently included the generalizability statement under "study limitations" section thus creating some confusion. We have however relocated this statement. We believe these findings would be readily extendable to populations of pregnant women presenting for ANC services in similar low- and middle-income settings.

8. Also include limitation that this study was a facility-based study as opposed to population based. We know majority of depressed ladies may not go for antenatal care, hence some bias in sample selection.

Since this was a facility-based study, we have included the possibility of selection bias as a potential study limitation in the manuscript.

9. The conclusion can be considered an over reach. It appears as if the authors did an intervention study that identified these specific interventions to work while instead they have simply identified risk factors in a small non generalized population. I believe the conclusion should call for more research around specific risk factors identified (violence and social support and how it relates to prenatal depression). This study goal was not to screen nor examine the interventions postulated in the conclusion but to identify predictors/risk factors. Also results were not generalizable. Consider including future studies on the same for a larger more generalizable studies with these predictors included or more studies that replicate similar findings to establish these predictors. Perhaps also test interventions that can address this predictor.

In the conclusion section as recommended, we have indicated opportunities for future research to build on the present study.

Competing Interests: There are no competing interests.