Socioeconomic and health predictors of perinatal mental health in a rural area of The Gambia

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Conflict of interest statement: The authors declare no conflict of interest.

Data availability statement: Data supporting this paper will be made available subject to established data sharing agreements.

Acknowledgements: We would like to thank all families participating in this research, without whom this work would not have been possible. Furthermore, we would like to dedicate a special mention to Dr Momodou K. Darboe, who was the lead co-investigator of the BRIGHT project in Keneba at the MRCG at LHSTM and contributed to the grant applications that funded this work. He supported the team at the local site and provided an invaluable contribution to the adaptation of measures for the local context. He died in 2021, before he was able to see the conclusion of this research project. This research is funded by the Bill and Melinda Gates Foundation (grants OPP1061089 and OPP1127625). The Nutrition Theme at MRCG is supported by the MRC & the Department for International Development (DFID) under the MRC/DFID Concordat agreement (MRC Programme MC-A760-5QX00). BM is supported by a UKRI ESRC Secondary Data Analysis Initiative Grant (ES/V016601/1). SEM is supported by a Wellcome Trust Senior Research Fellowship (220225/Z/20/Z). SLF is supported by a UKRI Future Leaders Fellowship (grant number MR/S018425/1). *This work is supported by the NIHR GOSH BRC. The views expressed are*

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Abstract

Background: Prevalence and predictors of perinatal mental health are understudied in majority world contexts. The present study investigated a range of co-occurring perinatal mood conditions (depression, perceived stress, and pregnancy anxiety) in a rural area of The Gambia, West Africa. The aims were to adapt self-report measures for use in this setting, and then to use the adapted tool to examine relevant socioeconomic (SES) and health-related predictors.

Methods: Participants included *N*=205 women in their third trimester of pregnancy who were taking part in the Brain Imaging for Global Health (BRIGHT) project. Mental health was reported by women using the Edinburgh Postnatal Depression Scale (EPDS), Perceived Stress Scale (PSS), Pregnancy Specific Anxiety Scale (PSA), and Pregnancy Related Anxiety Scale (PRAS). The measures were adapted for the Mandinka language, with necessary contextual adaptations. SES and health factors included maternal age, parity, educational attainment, income, occupation, household size, and anaemia.

Results: Participants reported low levels of distress or inability to cope. Measures varied in their utility; the PRAS had the highest internal consistency (IC) and showed associations with predicted SES factors. All measures were significantly correlated with each other. Lower income, being a farmer, and greater household size predicted higher anxiety and stress, while none of the factors predicted depression.

Conclusion: Overall, pregnant women in this setting to did not report heightened mental health difficulties. However, poverty-related factors contributed to greater stress and anxiety. We highlight the importance of examining multiple, overlapping conditions and a wider range of predictors in diverse contexts.

Perinatal mental health difficulties are highly prevalent globally and are associated with birth complications, postnatal mental health difficulties, and disrupted caregiving practices (Dadi et al., 2020a, 2020b). The vast majority of research investigating the aetiology and risk factors of, as well as the development of tools to assess, perinatal mental health has been conducted on a narrow subset of the world population, mainly in high-income countries (HICs) (Stevenson et al., 2023). This is in spite of reports that these difficulties are more prevalent among women in low- and middle-income countries (LMICs) due to heightened exposure to poverty-related risks and fewer resources available for support (Mitchell et al., 2023). Consequently, there is a pressing need to expand our knowledge of both the measurement and context-specific predictors of perinatal mental health in more diverse settings, to aid in the correct identification and development of interventions.

One substantial gap in research examining mental health in LMICs is the narrow focus on individual mental health conditions (Kane et al., 2018). There is often high co-occurrence of mental health difficulties, and understanding their overlap and shared predictors is vital for tailoring interventions for individuals' needs (Kane et al., 2018). In the domain of perinatal mental health, research has largely focussed on depression (Dadi et al., 2020b; Gelaye et al., 2016). Accurately measuring depression can be challenging due to the stigma, particularly around suicide, that exists in many communities (Abdulmalik et al., 2014; Hanlon et al., 2008; Tesfaye et al., 2010). Furthermore, depression frequently co-occurs with other mood disorders (ter Meulen et al., 2021), and while these conditions are interrelated, they also have independent impacts on both birth outcomes and subsequent parenting (Staneva et al., 2015). For example, perceived stress, a psychological state in which one perceives environmental demands as greater than their coping abilities (Epel et al., 2018), is highly relevant for the onset of depression and anxiety (Aneja et al., 2017; Cristóbal-

Narváez et al., 2020; Premji et al., 2020) but is also independently related to poor birth and health outcomes (Staneva et al., 2015; Tanpradit and Kaewkiattikun, 2020).

Another relevant, but understudied condition, is pregnancy anxiety. This can be both affect-based (e.g., fear related to the pregnancy) or involve specific concerns about the health of the foetus, labour, and the family's financial situation (Bayrampour et al., 2016). Pregnancy anxiety has been reported as a better determinant of obstetric complications than generalised anxiety (Slade et al., 2021; Reck et al., 2013; Rahman et al., 2008). Chandra and Nanjundaswamy (2020) propose pregnancy anxiety as a particularly important problem for women in LMICs, because issues like infant mortality, lack of access to healthcare and undernutrition remain highly prevalent in some communities, contributing to elevated fears about the outcomes of their pregnancies.

A number of foundational studies in LMICs have examined the rates and psychosocial predictors of perinatal depression (Atuhaire et al., 2020; Endomba et al., 2021; Roddy Mitchell et al., 2023), but the literature examining pregnancy anxiety (Bayrampour et al., 2016; Hadfield et al., 2022; Nath et al., 2019) and perceived stress (e.g., Katus et al., 2022) is still emergent. A number of poverty-related factors, including low income, household overcrowding, food insecurity, and gender inequality have consistently been found to predict elevated mood difficulties during pregnancy across cultural contexts in LMICs (Atif et al., 2015; Lund et al., 2010; McNab et al., 2022). Conversely, factors related to higher autonomy and stability, such as higher educational attainment and having a permanent job, were among reported protective factors (Fisher et al., 2012).

In spite of these important associations, a number of relevant environmental stressors have not been as widely investigated in these settings but warrant increased attention. For example, iron deficiency anaemia (IDA) is highly prevalent among women of reproductive age in LMICs (Kinyoki et al., 2021) and, during pregnancy and in the absence of iron

interventions, tends to increase in severity from the first to the third trimester (Wemakor, 2019). Iron is vital for a number of biochemical processes in the brain, as well as general health and wellbeing (Abbaspour et al., 2014; Beard and Connor, 2003; Kim and Wessling-Resnick, 2014; Wang et al., 2019). In line with this, in HIC settings, IDA has been associated with increased depression during pregnancy (Dama et al., 2018; Kemppinen et al., 2022), but remains under-investigated in LMICs. Additionally, a large proportion of women in LMICs work in agriculture (Anderson et al., 2020); the heavy physical work and exposure to heat stress during pregnancy have been related to compromised maternal and infant physical health (Bonell et al., 2022; Pradeilles et al., 2019; Spencer et al., 2022). However, to our knowledge, the mental health of pregnant farmers has not been investigated.

Study context and aims

The present study uses data from the Brain Imaging for Global Health project (BRIGHT; www.globalfnirs.org/the-bright-project), a prospective longitudinal study of child development from the antenatal period to preschool age in the West Kiang region, a rural area of The Gambia, West Africa. This community are largely subsistence farmers, and both income and food security vary substantially between the annual rainy and dry seasons (Hennig et al., 2015; van der Merwe et al., 2013). Consequently, nutritional deficiencies, such as IDA, are highly prevalent (Shitu and Terefe, 2022). Furthermore, literacy rates and educational attainment among women in this community remain low (Hennig et al., 2015; Nabwera et al., 2018). Women largely work in agriculture, where exposure to heat stress is high and has been associated with complications during pregnancy (Bonell et al., 2022). In spite of these important risk factors, a small number of studies in this particular setting, and in The Gambia more generally, have examined perinatal mental health and all have focussed predominantly on depression (Coleman et al., 2006; Nabwera et al., 2017; Sanfilippo et al., 2023, 2019; Stewart et al., 2022). In a nearby rural community in The Gambia, women in the

postpartum period surprisingly reported fewer depressive symptoms than women who were not pregnant or postpartum (Coleman et al., 2006). Furthermore, in West Kiang, Nabwera et al. (2018) found that maternal depression did not predict infant wasting. It is possible that, in this family-oriented community, women enjoy enhanced support during pregnancy and after childbirth, which serves as a protective factor. However, this also highlights the need to investigate the nature and predictors of poor mental health among women who do report heightened symptoms.

The present study aims to build on this foundational work and expand the scope of perinatal mood-related mental health conditions studied in the rural Gambian setting, by incorporating measures of perinatal depression, perceived stress, and pregnancy anxiety. We also include a broader scope of SES and health-related predictors. Firstly, we describe the adaptation of measures used to assess these mental health conditions and evaluate their psychometric properties. Furthermore, we assess the contribution of income, educational attainment, household size, parity, anaemia, and work in agriculture on mental health during pregnancy.

Methods

Participants

Families were recruited during antenatal clinic visits at the Medical Research Council Unit The Gambia at the London School of Hygiene and Tropical Medicine (MRCG at LSHTM; www.mrc.gm). Mothers were initially seen at 34-36 weeks' gestation and infants were assessed at multiple study visits from infancy to preschool age. Eligibility criteria for pregnant women included being healthy (confirmed by study midwife), carrying a singleton pregnancy, and being a native speaker of Mandinka. The sample consisted of *N*=205 families (for further details see Lloyd-Fox et al., under review). Ethical approval was granted by the joint Gambia Government–MRC Unit The Gambia Ethics Committee (project title

'*Developing brain function for age curves from birth using novel biomarkers of neurocognitive function*', SCC number 1451v2).

Measures

Mental health was assessed at the antenatal visit using interviewer-administered questionnaires, adapted for this setting following protocols outlined by the World Health Organisation (WHO; World Health Organization, 2013) and studies in LMICs (Coleman et al., 2006; Hanlon et al., 2008; Kohrt et al., 2016; Nabwera et al., 2018; Tesfaye et al., 2010; Weobong et al., 2015). Measures were translated into Mandinka by a panel of native Mandinka-speaking staff and back-translated by staff blind to the original questionnaires. Consultations were conducted with local clinical staff and families to discuss the language and content of the measures. For details of staff training and piloting see Lloyd-Fox et al. (under review).

The ***Edinburgh Postnatal Depression Scale*** (EPDS; Cox et al., 1987) is one of the most widely used measures of perinatal depression in Africa (Atuhaire et al., 2020) and has previously been used in The Gambia (Coleman et al., 2006; Nabwera et al., 2018; Sanfilippo et al., 2019; Stewart et al., 2022). The questionnaire consists of 10-items and asks participants to rate how frequently they experienced depressive symptoms over the last week on scale of 0-3 ("Not at all"-"Most of the time"). Sum scores range from 0-40, with scores of ≥10 indicating clinically significant symptoms. However, a threshold of >6 has been suggested as a better indicator of clinical symptoms in other African communities (Tesfaye et al., 2010). An item asking about suicidal ideation was removed due to its highly sensitive nature. Instead, participants were asked about wanting to be alone/secluded, which is viewed as a sign of illness due to the communal lifestyle in this setting (Coleman et al., 2006). Participants who scored ≥10 were offered a referral to the MRC clinic.

The ***Perceived Stress Scale*** (PSS; Cohen et al., 1983) consists of 10-items and asks participants to rate how frequently they experienced stress-related feelings over the past month on a scale of 0-4 ("Never"-"Very often"). Sum scores range from 0-40. The PSS has demonstrated robust psychometric properties across a range of LMIC settings (Katus et al., 2022).

The ***Pregnancy Related Anxiety Scale*** (PRAS; Rini et al., 1999) consists of 10-items and asks participants to rate how frequently they had concerns about their pregnancy over the last few months, on a scale of 1-4 ("Not at all"-"A lot of the time"). Sum scores range from 10-40.

The ***Pregnancy Specific Anxiety scale*** (PSA; Roesch et al., 2004) consists of 13-items and asks participants to indicate how frequently they experienced feelings related to fear/panic about their pregnancy over the last week on a scale of 1-5 ("Never" – "Always"). Four target items measure PSA symptoms, sum scores range from 4-20. Scores on the PRAS and PSA were rescaled to make the lowest score 0 (rather than 1), leaving sum score ranges of 0-30 and 0-16, respectively.

Due to low literacy rates among participants, questionnaires were administered as interviews by field staff. To reduce recall burden, participants were initially asked if they experienced the target symptom (yes/no) and were only presented with frequency options if they affirmed.

SES and family characteristics were assessed using a field-assistant administered questionnaire at the infant's 7-14-day visit. Mothers were asked about their educational attainment, their own and their partner's annual income from 6 income-bands in Gambian Dalasi (<2000D, 2000-2500D, 2500-5000D, 5000-10000D, 10000-25000D, and >25000D [converting to approximately <$30 to >$400]), their occupation, household size, and parity. Because many mothers had no formal education (see results), maternal education was

transformed into a dichotomous variable (some/no formal education). To reduce the number of income bands, a dichotomous variable was created to indicate *lower* (<2000-5000D for mothers, <2000-250000 for fathers) and *higher* income (5000>25000 for mothers, >250000 for fathers). Finally, a dichotomous variable was created for maternal occupation (farmer/non-farmer).

Maternal anaemia was assessed via haemoglobin (Hb) concentrations measured on blood samples collected at the antenatal visit. WHO (2016) criteria suggest an anaemia cut-off of 11.0g/dL Hb in the third trimester of pregnancy. However, given that average Hb in the sample was 11.0g/dL (see results), we used a criterion of 10.0g/dL as an indicator of anaemia. This is the cut-off used by the Gambian healthcare system to administer treatment.

Data analysis strategy

Analyses were performed in RStudio (RStudio Team, 2020). To evaluate the appropriateness of using linear regression, each mental health questionnaire was assessed for violations of normality (using Shapiro Wilk test) and excessive skewness (scores <-1 or >+1 indicating a strong skew). Internal consistency (IC) of each measure was assessed using Cronbach's alpha. Associations between mental health measures were assessed using Spearman rank correlation, with false discovery rate (FDR) correction applied.

Regression analyses were used to examine the associations between mental health scores, SES, and health factors. Zero-inflated Poisson (ZIP) regressions (Lambert, 1992) were used to assess predictors of EPDS, PSA and PRAS due to the excess zero-scores in these data (see results), using the *PSCL* package (Jackman, 2020). ZIP models postulate that excess zeroes are produced by a different model from the count data and, therefore, contain two parts – a Poisson model to predict the count data and a logit model for the excess zeroes (Hur et al., 2002; Wang et al., 2002). Dispersion of the ZIP regressions was assessed to ensure that values were close to 1 (Yang et al., 2009). Linear regression was used for the PSS

using the *LM Test* package (Zeileis and Hothorn, 2002). Univariate models were used to assess the independent contributions of maternal age, parity, education, income, occupation, household size, and anaemia status on mental health scores. Subsequently, multivariate models were run where all the predictors were entered into the model together, to examine their joint contribution. Again, FDR correction was applied, and findings are presented with both raw and corrected *p*-values.

We acknowledge the important contribution of paternal income to both household SES and maternal wellbeing (Nabwera et al., 2018), but sought to examine the contribution of maternal factors alone to avoid paternal factors overshadowing these associations. However, regression analyses were repeated to include paternal income and are reported in Supplementary Materials 1.

Results

Demographic characteristics and mental health scores

A summary of the mental health scores, demographic and SES characteristics are summarised in Table 1. Distributions of and correlations between mental health measures are presented in Figure 1.

EPDS (W=.93, p<.001, skew=.85), PSA (W=.77, p<.001, skew=1.51), and PRAS (W=.74, p<.001, skew=1.71) had non-normal, skewed distributions, with excess zero-scores (see Figure 1). PSS had a marginally non-normal distribution but did not exhibit high skewness (W=.98, p=.05, skew=.06) or excess zero-scores.

PRAS (α=.80) and PSA had high and moderate IC (α=.62), respectively. EPDS (α=.43) and PSS (α=.41) had low IC. Correlations between mental health measures were all significant.

Table 1: Summary of mental health scores, socioeconomic and health characteristics

Mental health measures	
EPDS [*N, M* (SD)]	*N*=164, 3.84 (2.91)
Total EPDS score ≥10 (*N*, %)	5, 3.05%
Total EPDS score >6 (*N*, %)	26, 15.85%
PSS [*N, M* (SD)]	*N*=165, 9.07 (4.06)
PRAS [*N, M* (SD)]	*N*=165, 2.78 (3.95)
PSA [*N, M* (SD)]	*N*=165, 1.69 (2.24)
Maternal age (y)	
Mean (SD), range	29.80 (6.67), 18.23 - 44.71
Maternal education	
Ever attended school (*N*, %)	
Did not attend school	101 (59.41%)
Attended some school	69 (40.59%)
Years in school (if attended)	
Mean (SD)	7.41 (3.18)
Range	1.00 – 12.00
Maternal income band (*N*, %)	
Higher income (5000->25000 Dalasi)	67 (39.64%)
Lower income (<2000-5000 Dalasi)	102 (60.36%)
Maternal occupation	
Occupation as farmer (*N*, %)	
Farmer	111 (65.68%)
Non-farmer	58 (34.32%)
Occupation, if not farmer (*N*, %)	
Housewife	16 (27.59%)
Tradeswoman	1 (1.72%)
Student	4 (6.90%)
Other	37 (23.42%)
Maternal Anaemia (*N*, %)	
Anaemic (Hb <10g/dL)	31 (18.79%)
Not anaemic (Hb >10g/dL)	134 (81.21%)
Hb levels (g/dL; M, SD)	
Whole sample	11.05 (1.31)
Anaemic	10.06 (.69)
Not anaemic	12.05 (.98)
Parity and household composition	
Parity (*N*, %)	
Multiparous	140 (82.35%)
Nulliparous	30 (17.65%)
If multiparous, no. living children	
Mean (SD)	4.10 (2.10)
Range	1 - 9
Overall household size	
Mean (SD)	12.79 (6.43)
Range	3 - 36
Paternal income band (*N*, %)	
Higher income (<2000-250000 Dalasi)	104 (61.54%)
Lower income (>250000 Dalasi)	65 (38.46%)

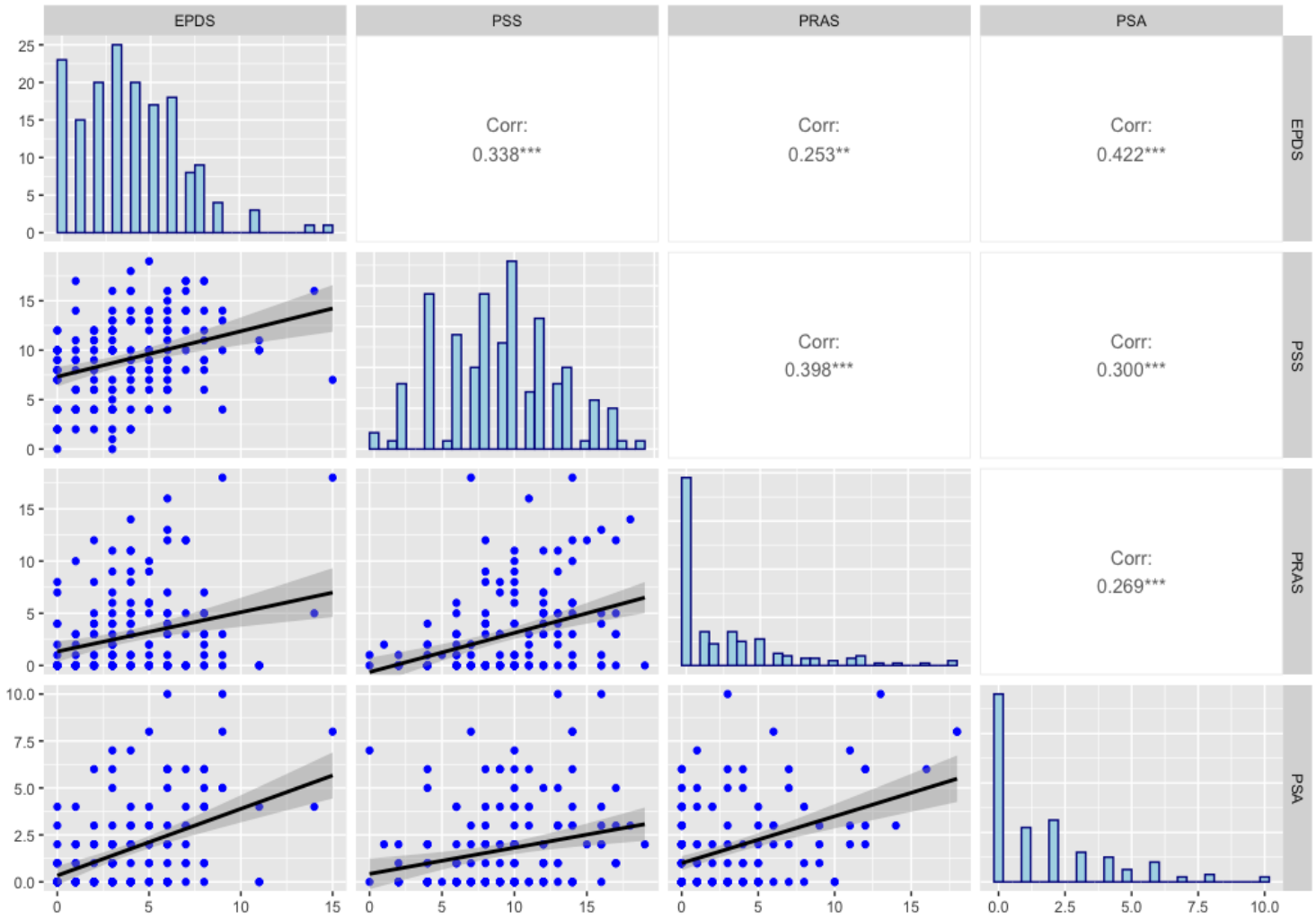

Figure 1. Histograms show distributions of the Edinburgh Postnatal Depression Scale (EPDS), Perceived Stress Scale (PSS), Pregnancy Anxiety Scale (PSA), and Pregnancy Related Anxiety Scale (PRAS). Strength of association between each measure is indicated by Spearman correlation coefficients ($^{***}p<.001$, $^{**}p<.05$) and scatterplots.

Association between maternal mental health, socioeconomic and health factors

Univariate and multivariate regression models are presented in Tables 2 to 5.

PSS: In the univariate models, higher maternal income and age predicted lower PSS scores at significance and trend-level, respectively. Greater household size predicted higher PSS at trend-level. These associations did not survive FDR correction. In the multivariate model, only greater household size significantly predicted higher PSS scores.

Table 2: Associations between socioeconomic, health factors and perinatal perceived stress (Perceived Stress Scale [PSS] scores)

	Count model coefficients				
	β	*SE*	*t*	*p-value*	*Corrected p-value*
Univariate associations					
Age	-.09	.05	-1.84	.07^{+}	.16
Parity	-.80	.88	-.90	.37	.59
Education	.02	.08	.30	.77	.77
Income	-1.49	.68	-2.18	.03*	.16
Occupation	-.25	.71	-.36	.72	.77
Household size	.11	.06	2.02	.05^{+}	.16
Anaemia	.69	.85	.81	.42	.59
Multivariate associations					
Intercept	9.90	1.92	5.17	<.001**	<.001**
Age	-.07	.07	-1.00	.32	.64
Parity	-.42	1.10	-.38	.71	.95
Education	-.01	.10	-.12	.90	.95
Income	-1.26	.75	-1.68	.10	.27
Occupation	-.05	.88	-.06	.95	.95
Household size	.16	.06	2.62	.01*	.04*
Anaemia	.21	1.00	.21	.83	.95

^{+}p<.10, $^{*}p$<.05, $^{**}p$<.01, $^{***}p$<.001

EPDS: In the count model, there were no significant univariate or multivariate associations. In the univariate zero-inflation models, higher maternal age was marginally associated with more excess zero-scores. However, in the multivariate zero-inflation model, this became non-significant, but greater household size marginally predicted fewer excess zero-scores. None of the associations survived FDR correction.

Table 3: Associations between socioeconomic, health factors and perinatal depression (Edinburgh Postnatal Depression Scale [EPDS] scores)

	Count model coefficients					Zero inflation model coefficients				
	β	*SE*	*z*	*p-value*	*Corrected p-value*	*β*	*SE*	*z*	*p-value*	*Corrected p-value*
Univariate associations										
Age	-.00	.01	-.34	.73	.99	.01	.04	1.68	.09^{+}	.33
Parity	.00	.11	.01	.99	.99	.95	.89	1.06	.29	.51
Education	-.00	.01	-.34	.74	.99	-.03	.06	-.43	.67	.90
Income	-.07	.09	-.75	.46	.99	.08	.51	.15	.88	.90
Occupation	-.01	.09	-.08	.94	.99	1.06	.66	1.60	.11	.33
Household size	.00	.01	.56	.58	.99	-.08	.05	-1.49	.14	.33
Anaemia	.08	.11	.74	.46	.99	.08	.64	.12	.90	.90
Multivariate associations (dispersion = 1.02)										
Intercept	1.57	.24	5.12	<.001	<.001	-4.47	2.86	-1.56	.12	.48
Age	-.00	.01	-.32	.75	.86	.08	.06	1.33	.18	.48
Parity	.02	.15	.12	.91	.91	.79	1.79	.45	.66	.93
Education	-.00	.01	-.41	.69	.86	.02	.09	.18	.86	.93
Income	-.07	.10	-.72	.47	.86	.10	.60	.16	.87	.93
Occupation	-.07	.11	-.58	.56	.86	1.12	.98	1.15	.25	.50
Household size	.01	.01	.78	.44	.86	-.13	.07	-1.90	.06^{+}	.48
Anaemia	.07	.16	.44	.66	86	-.08	.88	-.09	.93	.93

^{+}p<.10, $^{*}p$<.05, $^{**}p$<.01, $^{***}p$<.001

PSA: In the univariate count models, anaemic mothers reported higher PSA scores. In the multivariate count model, this association remained at trend-level (but was non-significant after FDR correction). In the univariate zero-inflation model, greater household size was associated with reduced excess zero-scores. In the multivariate zero-inflation model, this association remained significant, and the association with maternal occupation also became significant, whereby farmers had fewer excess zero-scores. However, these associations did not survive FDR correction.

Table 4: Associations between socioeconomic, health factors and pregnancy specific anxiety (Pregnancy Specific Anxiety [PSA] scores)

	Count model coefficients					Zero inflation model coefficients				
	β	*SE*	*z*	*p-value*	*Corrected p-value*	*β*	*SE*	*z*	*p-value*	*Corrected p-value*
Univariate associations										
Age	.02	.01	1.66	.10	.35	.01	.03	.31	.76	.96
Parity	-.12	.18	-.65	.52	.65	-.10	.47	-.21	.83	.96
Education	-.01	.02	-.51	.61	.65	.01	.04	.20	.85	.96
Income	-.07	.15	-.46	.65	.65	-.02	.37	-.05	.96	.96
Occupation	.07	.15	.47	.64	.65	.67	.40	1.66	.10	.35
Household size	.01	.01	.57	.57	.65	-.08	.03	-2.32	.02*	.14
Anaemia	.43	.14	3.01	.002**	.01*	-.62	.46	-1.33	.18	.42
Multivariate associations (dispersion = .95)										
Intercept	.72	.43	1.66	.10	.32	.27	1.11	.24	.81	.88
Age	.02	.02	.99	.32	.51	.01	.04	.36	.72	.88
Parity	-.37	.24	-1.54	.12	.32	-.61	.66	-.93	.35	.70
Education	.004	.02	.20	.84	.84	.02	.05	.44	.66	.88
Income	-.14	.18	-.77	.44	.59	.06	.44	.15	.88	.88
Occupation	-.06	.17	-.34	.74	.84	1.07	.53	2.03	.04*	.16
Household size	.01	.01	1.09	.28	.51	-.09	.04	-2.43	.02*	.16
Anaemia	.35	.19	1.85	.06+	.32	-.71	.57	-1.26	.21	.56

+*p*<.10, **p*<.05, ***p*<.01, ****p*<.001

PRAS: In the univariate count model, greater household size and being anaemic significantly predicted higher PRAS scores. Being a farmer also predicted higher scores at trend-level. Higher maternal income was associated with lower PRAS scores (but fell to trend-level after FDR correction). In the multivariate count model, the associations between household size and income remained significant, while being a farmer significantly predicted PRAS scores (but became trend-level after FDR correction). Multiparity significantly predicted lower PRAS scores. On the other hand, the association with anaemia became non-

significant. The zero-inflation model univariate analyses revealed trend-level associations between higher maternal age, multiparity and excess zero-scores. These did not hold up in the multivariate zero-inflation model, however greater household size was marginally related to lower excess zero-scores (but became non-significant after FDR correction).

Table 5: Associations between socioeconomic, health factors and pregnancy related anxiety (Pregnancy Related Anxiety Scale [PRAS] scores)

	Count model coefficients					Zero inflation model coefficients				
	β	*SE*	*z*	*p-value*	*Corrected p-value*	*β*	*SE*	*z*	*p-value*	*Corrected p-value*
Univariate associations										
Age	.01	.08	1.63	.10	.14	.05	.02	1.87	.06^{+}	.28
Parity	-.06	.12	-.47	.64	.75	.79	.47	1.68	.09^{+}	.28
Education	.00	.01	.06	.95	.95	-.03	.04	-.77	.44	.51
Income	-.29	.11	-2.30	.02*	.05^{+}	-.02	.35	-.05	.96	.96
Occupation	.22	.11	1.98	.05^{+}	.09^{+}	.49	.37	1.34	.18	.28
Household size	.03	.01	4.26	<.001**	<.001**	-.04	.03	-1.36	.18	.28
Anaemia	.31	.12	2.50	.01*	.04*	.55	.42	1.30	.20	.28
Multivariate associations (dispersion = 1.17)										
Intercept	1.29	.33	3.93	<.001**	<.001**	-1.18	1.05	-1.13	.26	.52
Age	.00	.01	.10	.92	.92	.04	.04	1.15	.25	.52
Parity	-.39	.17	-2.26	.02*	.04*	.22	.60	.36	.72	.94
Education	.00	.02	.11	.91	.92	.01	.05	.22	.83	.94
Income	-.31	.13	-2.41	.02*	.04*	-.03	.40	-.07	.94	.94
Occupation	.33	.15	2.17	.03*	.05^{+}	.31	.48	.65	.52	.83
Household size	.03	.01	4.00	<.001**	<.001	-.06	.03	-1.84	.07^{+}	.52
Anaemia	.03	.19	.14	.89	.92	.71	.54	1.32	.19	.52

$^{+}p<.10$, $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$

Discussion

This study is the first to examine multiple distinct, but related, perinatal mental health difficulties (depression, perceived stress, and pregnancy anxiety) in a rural Gambian community. Mental health measures were adapted and implemented with varied success; measures of pregnancy anxiety had better psychometric properties and greater sensitivity to detecting associations with SES and health predictors than measures of stress and depression. The inclusion of co-occurring mood difficulties and examination of shared and distinct predictors allowed for a nuanced investigation of mental health during pregnancy in a population where this remains under-studied.

Measurement of mental health

Participants reported low levels of emotional distress; scores on the mental health measures were heavily skewed towards zero and only 3% of the sample scored in the clinically significant range for depressive symptoms, according to the EPDS. The proportion within the clinical range increased to 15% when a lower EPDS threshold, previously recommended for use in other rural African communities, was applied (Hanlon et al., 2008; Tesfaye et al., 2010). These rates correspond with previously reported prevalence of depressive symptoms among pregnant women in The Gambia (Sanfilippo et al., 2023). Furthermore, in a nearby Gambian community, women in the postpartum period reported lower depressive symptoms than women who were not pregnant or postpartum (Coleman et al., 2006). The distribution of perceived stress scores was more varied, with women considerably more likely to report symptoms. Rural communities in The Gambia are highly family-oriented; families live in kin-based clusters and childrearing is viewed as a shared practice (Brotherton et al., 2021; Sear et al., 2000). In the face of environmental adversity, these social networks may serve as protective factors against mental distress during pregnancy. Therefore, while pregnant women report being affected by stress, this may not

necessarily result in low mood or inability to cope. However, as a consequence of enhanced social support, pregnant women may also be more reluctant to report negative feelings (Abdulmalik et al., 2014; Nabwera et al., 2018). This is particularly relevant given that our measures were administered as face-to-face interviews by field staff; social desirability, stigma, and recall bias likely played an important role (Bergen and Labonté, 2019). It may, therefore, be necessary to recalibrate the criteria for mental health difficulties to be sensitive to participants who report *some* symptoms, where cultural norms discourage this. Nevertheless, significant associations between the questionnaires suggest that they measured similar constructs.

Psychometric properties were varied; measures of pregnancy anxiety exhibited highest IC, while depression (EPDS) and stress (PSS) had low IC. Notably, the EPDS had almost identical IC to that reported by Hanlon et al. (2008) and Tesfaye et al. (2010), whose work in Ethiopia our adaptions were partly modelled on. A potential explanation for these discrepant psychometric properties is that the PRAS queries practical concerns, while the EPDS and PSS contain lengthy statements describing emotional experiences, with both positively and negatively framed items. The added complexity could have made it more difficult for participants to respond cohesively to items, particularly in an interview setting. To reduce recall burden, participants were presented with frequency options only if they reported experiencing a target symptom. This may have invertedly removed the opportunity to respond in a nuanced manner and encouraged participants to only endorse certain items (e.g., more socially acceptable ones).

It is also possible that the way mental health is conceptualised on these measures does not fully resonate in this setting. For example, prior studies using the EPDS in Africa have reported difficulties translating some items into local languages and suggested that women found these items difficult to understand (Hanlon et al., 2008; Tesfaye et al., 2010). Another

study in The Gambia also found that women reported higher somatic, rather than emotional, symptoms (Sanfilippo et al., 2023). Thus, more work is needed to better understand how individuals in different cultural contexts experience depression, stress, and anxiety, and measures developed in Minority World contexts should be interpreted with care (Sanfilippo et al., 2023).

Socioeconomic and health predictors of mental health

Several statistically significant associations emerged between mental health, SES, and physical health predictors. The PRAS demonstrated the greatest number of significant associations; being nulliparous, having lower income, being a farmer, and living in a larger household were associated with higher pregnancy anxiety. Similarly, higher perceived stress (PSS) was predicted by lower income and larger household size, but only household size remained significant when all factors were considered together. We note that, as expected, paternal income tempered some of these relationships (see Supplementary Materials) and not all significant associations survived correction for multiple testing. Nevertheless, these relationships highlight the role of financial security and autonomy in women's wellbeing during pregnancy.

Work in other LMICs has found maternal employment to predict better child growth, likely because an independent source of income gives women greater autonomy in distributing household resources, allowing them to prioritise the needs of their children (Brauner-Otto et al., 2019; Oddo et al., 2018; Oddo and Ickes, 2018). Polygyny and living with extended kin are commonplace in this community (Brotherton et al., 2021; Hennig et al., 2015; Sear et al., 2000; Sear and Mace, 2009), and our data show evidence of household overcrowding (the largest household consisted of 36 members). Thus, an independent source of income likely provides important reprieve for expectant mothers. We were unable to encapsulate all relevant familial factors, such as family dynamics or intimate partner

violence, which are recognised as important predictors in prior research (Da Thi Tran et al., 2022). Surprisingly, maternal education was not associated with any form of mental health. Women in our sample who attended school only completed, on average, 7-years. There may have been insufficient diversity in educational attainment to capture its impact on mental health. It is also possible that women who never enrolled in school were from more traditional households and, thus, susceptible to stigma.

The nature of one's employment was also an important factor - being a farmer was associated with higher pregnancy anxiety (on the PRAS). Prior work in this community demonstrated that the physical stressors of farming were associated with poorer maternal and foetal health (Bonell et al., 2022). These stressors may also erode women's psychological wellbeing during pregnancy. Anaemic women also reported more pregnancy anxiety (on PRAS and PSA), but these associations did not hold up when other factors were considered. Given prior associations (Goshtasebi et al., 2013; Wassef et al., 2018), it is surprising that anaemia was not associated with depression. While a substantial portion of women in our sample had anaemia, both anaemic and non-anaemic women were, on average, close to the clinical cut-off and very few had severe anaemia (Hb < 7g/dL). Perhaps inclusion of more severely anaemic women is needed to detect an impact of anaemia on mental health.

Implications and future directions

In spite of the challenges of assessing mental health in this cultural context, some participants reported heightened mental health difficulties, and these were associated with relevant contextual factors. Thus, sensitivity is needed for women from lower SES backgrounds, with less financial autonomy, and those working in agriculture. On the other hand, understanding why some women experience stress and worry during pregnancy, but do not develop depression, is also important as it may signal important protective factors that could be harnessed for support and future interventions. While this study is among several

that examines mental health during pregnancy, longitudinal work, tracking the progression of mental health symptoms remains scarce. Thus, future research is needed to examine the trajectory of mental health difficulties in the postnatal period and the impact of this on both maternal and child physical, mental, and cognitive health.

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