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Social relationships and empowerment as risk factors for anemia among anxious pregnant women in Pakistan

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ABSTRACT

Background: Empowered women with social support are more likely to seek healthcare services, leading to better health outcomes. This study investigated spousal relationships, social support, and women's empowerment in relation to anemia in pregnant women living in urban areas of Rawalpindi, Pakistan.
Subjects and Method: A cross-sectional study enrolled 1,200 pregnant women at ≤ 22 weeks of gestation from Holy Family Hospital, Pakistan. The anxiety component of the Hospital Anxiety and Depression Scale (HADS) was used to assess eligibility, with a cutoff score of > 8. The quality of marital relationships, social support, and women's empowerment were evaluated using the MacArthur Relationship Questionnaire (MRQ), the Multidimensional Scale of Perceived Social Support (MSPSS), and an empowerment scale, respectively. Blood samples were collected to assess anemia in the participants. Descriptive statistics, risk ratios and bivariate analysis were conducted to explore the association.
Results: At enrollment, 29.7% of pregnant women exhibited mild anemia, 14.6% exhibited moderate anemia, and 0.3% exhibited severe anemia. Having a strong spousal relationship was significantly associated with decreased risk of anemia (RR=0.87; 95% CI= 0.82 to 0.93, p<0.001). However, social support from family members (excluding spouses) or friends did not show a significant association with the risk of anemia. Interestingly, financially empowered pregnant women had a higher risk of anemia compared to women who were not financially empowered (RR=1.14; 95% CI= 1.01 to 1.30; p= 0.040).
Conclusion: Support from a husband was associated with reduced risk of anemia in pregnant women in Pakistan. Enhancing spousal relationships and incorporating health literacy into empowerment programs could improve maternal health by lowering the risks of anemia.

Keywords: anemia; empowerment; social support; pregnancy, anxiety; Pakistan.

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BACKGROUND

Globally, approximately 40% of women experience anemia during pregnancy (WHO, 2023). Low socioeconomic status and limited access to resources contribute to the disproportionate impact of anemia on women of childbearing age, particularly in lower- and middle-income countries (LMICs) (WHO, 2023). In South Asia, anemia is prevalent across all age groups (Chaparro and Suchdev, 2019), but it poses significant risks for pregnant women (Al-Alimi et al., 2018)(WHO, 2008). Anemia during pregnancy is associated with premature delivery, low birth weight, poor cognitive development, and an increased risk of infant anemia after birth (Georgieff, 2011; Helmy et al., 2018).

The prime causes of anemia include nutritional deficiencies, inherited Red Blood cell (RBC) disorders, iron deficiency, a few infections such as malaria, schistosomiasis, and helminthiasis transmitted through soil (Hess et al., 2023). Furthermore, some obstetric and gynecological conditions lead to blood loss, erythrocyte destruction, and a decrease in erythropoiesis (Hess et al., 2023). Furthermore, pregnancy involves complex physiological changes that commonly lead to anemia (Mahfouz et al., 1994). Anemia is often linked to poverty, limited resources, and inadequate access to healthcare services (Nageen et al., 2022). Low socioeconomic status, nutrition illiteracy, low-quality food consumption, lack of supportive infrastructure, and little or no intent to cook are also modifiable determinants of anemia among university-going females in Pakistan (Khokhar et al., 2022).

While numerous studies have highlighted the correlation between socio-demographic factors such as low education, unstable employment, and large family size, and anemia (Biswas and Baruah, 2014; Khalid et al., 2018; Ullah et al., 2019). This inverse relationship between the occurrence of severe anemia among women and their social status has been reported in Pakistan (Batool et al., 2010).

Research suggests that social networks play a vital role in ensuring food security and promoting child growth in low-resource populations (Surkan et al., 2007; Lee et al., 2018). Additionally, social support is crucial for managing anemia (Morrison et al., 2021). Research suggests that pregnant women are more motivated to prevent anemia when they have access to the necessary information and emotional backing (Triharini et al., 2023). Furthermore, empowered women are more likely to find and utilize information, make informed nutritional choices, and seek appropriate healthcare services, such as regular prenatal check-ups and iron supplementation (Acharya et al., 2010; Ebot, 2014).

In Pakistan, the prevalence of anemia among pregnant women is particularly high, exceeding 50% in various hospital-based studies (Ullah et al., 2019). An alarming 90.5% prevalence of anemia among pregnant women was found in a community-based study (Baig-Ansari et al., 2008). Anemia remains a major maternal health challenge in Pakistan, necessitating a comprehensive understanding of modifiable risk factors to inform effective interventions. While biomedical factors are well-

documented, the role of psychosocial determinants, such as interpersonal relationships and individual agency, requires further exploration. Given this high prevalence and the potential importance of social and power relationships, topics that have not been extensively studied with respect to anemia, we aimed to examine whether the quality of spousal relationships, social support, and women's empowerment are associated with anemia in a sample of pregnant women exhibiting symptoms of anxiety in Pakistan. By examining these interrelated social factors, the study contributes to a more integrated approach to maternal health in a context with high prevalence.

SUBJECTS AND METHOD

1. Study Design

The study was conducted at Holy Family Hospital (HFH), a public tertiary hospital in Rawalpindi, which offers affordable antenatal services to a catchment population exceeding 7 million. This study utilized data from a randomized controlled trial (Clinical Trial.gov identifier NCT03880032) (Surkan et al., 2020), originally collected to evaluate the effectiveness of the Happy Mother–Health Baby (HMHB) program, designed to reduce anxiety among pregnant women.

2. Population and Sample

All pregnant women attending their initial prenatal visit at the Obstetrics and Gynecology Department of HFH were consecutively approached by trained female assessors for recruitment, screening, and informed consent. A multistage screening process was employed to enroll participants. In the initial stage, pregnant women aged 18 years or older and those with a gestation of 22 weeks or less were identified as eligible. The age criterion was based on the legal age of marriage in Pakistan. In the second stage, participants were screened for anxiety using the Hospital Anxiety and Depression Scale (HADS), with a score of ≥8 on the anxiety subscale indicating at least mild anxiety. Those who also scored ≥8 on the depression subscale of HADS were further assessed by a psychiatrist using the Structured Clinical Interview for DSM Disorders (SCID) to determine the presence of Major Depressive Episode (MDE). Women diagnosed with a Major Depressive Episode (MDE) were excluded, as the study aimed to examine the role of anxiety during pregnancy. The intervention specifically focused on whether reducing anxiety symptoms could help prevent the onset of postpartum depression. Exclusions included learning disabilities or a history of other severe psychiatric disorders. Using consecutive sampling, a total of 1,200 women were recruited from Holy Family Hospital (HFH).

3. Study Variables

In this study, anemia will be the dependent variable, whereas independent variables include women's empowerment, social support, and spousal support.

Covariates: Our exposures, MRQ, MSPSS, and household empowerment subscale scores were measured using questionnaires that gave a continuous score. Binary variables consisted of women's age (<25 or >25 years), women's education (≥ 8 or < 8 years), temporarily displaced (relocated to study site because of husband job or family reasons from other parts of the country), family structure (nuclear, joint, or extended family), gravidity (primigravida or multigravida), previous pregnancy loss (yes or no), and exposure to any physical violence at baseline (unexposed versus exposed). Monthly family income was classified based on the median (≥ or < 20,000 Pakistani Rupees (PKR) = US $79). We used a Mid-Upper Arm Circumference (MUAC) cutoff of < 23 cm to indicate malnutrition during pregnancy (Tang CM et al., 2016).

4. Operational Definition of Variables

Anemia: The primary outcome, anemia,

was defined according to World Health Organization hemoglobin thresholds for pregnancy. Participants were classified as anemic (1) if hemoglobin levels were below 11.0 g/dL in the first or third trimester or below 10.5 g/dL in the second trimester; all others were classified as non-anemic (0) (WHO, 1998). This binary variable was used in all regression analyses. Blood samples were taken to measure anemia at ≤22 weeks of gestation. An elastic band was placed on the upper arm to restrict the blood flow to withdraw a small amount from the vein in the participant's arm. The blood sample was collected in a small test tube, labeled, and sent to the laboratory for analysis.

Women's Empowerment: It was measured using items based on Naila Kabeer's (1999) framework (Kabeer and change, 1999) of resources, agency, and achievements. These items were already for the Pakistani context (Maselko et al., 2015). The HMHB study used this previously adapted version without further modification, capturing culturally relevant aspects such as financial autonomy, mobility, and asset ownership. Women's empowerment was assessed using two binary indicators adapted from a South Asian empowerment scale (Schuler et al., 1997). Financial empowerment was defined as a woman having both access to a lump sum for routine household expenses and independent decision-making authority over its use; women meeting both criteria were coded as empowered (1), and all others as not empowered (0). Household empowerment was defined as the absence of coercive restrictions in the past year. Women were coded as empowered (1) only if they reported none of the following: forced removal of property or assets, prevention from visiting their maternal home, or restriction from working outside the home. Both indicators were treated as binary exposures in analyses.

Social Support: Perceived social support was measured using the Multidimensional Scale of Perceived Social Support (MSPSS), a 12-item instrument that assesses the perceived availability of primarily emotional support. This scale has been validated and culturally adapted for use in Pakistan (Sharif et al., 2021). Items were scored on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). To avoid conceptual overlap with spousal support, the significant other subscale was excluded. Two subscale means were calculated: family support (4 items) and friend support (4 items). An overall social support score was computed as the mean of these two subscales, with higher scores indicating greater perceived support. All social support variables were treated as continuous in analyses.

Spousal Relationship Quality: Spousal relationship quality was assessed using a six-item version of the MacArthur Relationship Questionnaire (MRQ) (Seeman et al., 2001), which assesses emotional and instrumental support within intimate relationships. The scale captures both positive (e.g., feeling loved, emotional availability, practical help) and negative (e.g., excessive demands, criticism) aspects of the relationship. The items were translated and culturally adapted for use in Pakistan (Surkan et al., 2024), with contextually relevant examples and wording in Urdu to enhance clarity and local understanding. Participants responded on a 5-point Likert scale ranging from 0 = Never to 4 = Always. Three continuous subscales were derived: emotional support, instrumental support, and conflict/demand. For the overall relationship quality index, conflict/demand items were reverse-coded. A higher score indicates greater spousal support, including emotional care, open communication, and practical assistance. A lower score reflects limited or

strained support, potentially indicating emotional distance, lack of help, or controlling behaviors. All MRQ-derived measures were analyzed as continuous variables.

5. Study Instrument

The primary data collection tool for this study was a researcher-developed questionnaire consisting of three sections and a total of 43 items. The questionnaire underwent a thorough validation process to ensure its relevance and effectiveness. Initially, content and face validity were established through revisions made by clinical educators and mentors, who evaluated the specificity and alignment of each item with the research objectives. Construct validity was further supported by expert reviews, validity testing, and an extensive literature review that informed the questionnaire's development. To enhance its validity, a Content Validity Ratio (CVR) analysis was performed, retaining items with scores between 0.7 and 0.9, revising those with scores between 0.6 and 0.5, and excluding items that scored between 0.4 and 0.1. The reliability of the instrument was assessed through pilot testing, with Cronbach's Alpha calculated to evaluate internal consistency. The resulting Cronbach's Alpha value of 0.98 indicated a high level of internal consistency among the Likert-type responses, confirming the instrument's reliability.

6. Data Analysis

We began by describing the distribution of hemoglobin levels among the participants, examining the prevalence of anemia, and calculating descriptive statistics for demographic variables. To determine Risk Ratios (RRs), we employed log-binomial regression or, when log-binomial models failed to converge, we used Poisson regression with robust variance (Barros and Hirakata, 2003). Next, we conducted bivariate analyses to explore the relationship between baseline demographic characteristics and at least mild anemia. Variables that were associated with anemia at a significance level of $p < 0.05$ were considered potential confounders for subsequent multivariate regression models. We additionally controlled for income, given the documented association between low socioeconomic status and the prevalence of anemia (Noronha et al., 2012). These models assessed the relationships between spousal relationship quality, social support, and women's empowerment in relation to the risk of at least mild anemia. We adjusted these models for age, education, living status, MUAC, the number of family members, and monthly household income, using STATA 15.1 (Stata Corp, College Station, TX).

7. Research Ethics

The study was approved by the Johns Hopkins Bloomberg School of Health Institutional Review Board (Baltimore, USA), the Human Development Research Foundation Ethics Committee (Islamabad, Pakistan), the Rawalpindi Medical University (RMU) Institutional Research Forum (Rawalpindi, Pakistan), and the U.S. National Institute of Mental Health-appointed Global Mental Health Data Safety and Monitoring Board. All participants were well informed about the study and provided written informed consent before data collection. Data were collected using pretested interviewer-administered questionnaires.

RESULTS

In our 1,200 pregnant Pakistani women with at least mild anxiety symptoms, their Hemoglobin levels were normally distributed (Figure 1; p=0.345 for skewness and kurtosis test for normality). About 55.4% showed normal hemoglobin levels. About 29.7% showed mild anemia, 14.6% showed moderate anemia, and 0.33% showed severe anemia (Table 1).

Table 1. Degree of anemia among pregnant Pakistani women with at least mild anxiety symptoms

Classification	n (%)
Normal (Hg ≥11g/dL)	665 (55.4)
Mild (Hg 10 - <11g/dL)	356 (29.7)
Moderate (Hg 8 - <10g/dL)	175 (14.6)
Severe (Hg 6.5 - <8 g/dL)	4 (0.33)

Note: Anemia grading followed WHO (for pregnant women) and National Cancer Institute guidelines.

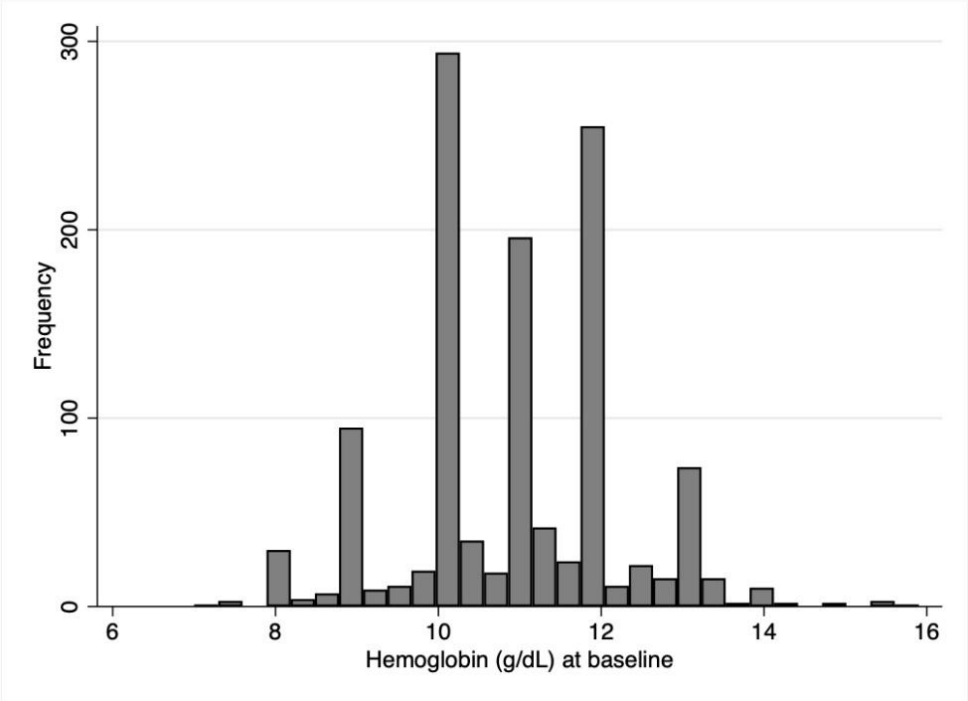

Figure 1. Distribution of hemoglobin (g/dL) in 1,200 pregnant Pakistani women with at least mild anxiety symptoms

Approximately 41.3% of the women studied were over the age of 25, and 54.7% had more than 8 years of education (Table 2). Older women (those over 25 years) and women with higher education levels (more than 8 years of schooling) had a 14% lower risk of anemia compared to their younger counterparts and those with lower education levels (RR=0.86, 95% CI: 0.75, 0.98 for age; and RR=0.86, 95% CI: 0.76, 0.98 for education).

Additionally, about 29.3% of the women were primigravida (experiencing their first pregnancy), and 41.6% had experienced pregnancy loss in a previous pregnancy. Approximately one-quarter (26.9%) were migrants, originally from outside the study area. Interestingly, being a migrant was linked to a decreased risk of anemia compared to those from the local area (RR=0.79, 95% CI: 0.68, 0.93).

About a tenth (10.8%) of participating women reported exposure to any form of physical violence, but this was not found to be a significant risk factor for anemia (RR=1.16, 95% CI: 0.97, 1.39). Furthermore, women whose mid-upper arm circumference (MUAC) was less than 23 cm (22.9% of the participants) had a 38% higher risk of anemia (RR=1.38, 95% CI: 1.22, 1.58).

Regarding household characteristics,

58.3% of the women's husbands had more than eight years of education, 68.7% lived in a non-nuclear family structure, and 64.6% reported their monthly household income to be 20,000 PKR (approximately US $70) or less. On average, women lived in households with 6.6 family members, and for every additional family member, there was a 2% increased risk of anemia (RR=1.02, 95% CI: 1.00, 1.03).

Table 2. Bivariate descriptive statistics for demographic characteristics in relation to having at least mild anemia at baseline in pregnant Pakistani women with at least mild anxiety (n=1,200)

Sample Characteristics	n (%)	RR (95% CI)	p
Participant characteristics			
Age (years)			
≤25	704 (58.7)	Ref	
>25	496 (41.3)	0.86 (0.75, 0.98)	0.030
Education level			
≤ Middle school (≤8 years)	544 (45.3)	Ref	
≥ Secondary school (>8 years)	656 (54.7)	0.86 (0.76, 0.98)	0.020
Gravidity			
Multigravida	848 (70.7)	Ref	
Primigravida	352 (29.3)	1.05 (0.91, 1.20)	0.520
Previous pregnancy loss			
No	701 (58.4)	Ref	
Yes	499 (41.6)	0.93 (0.82, 1.06)	0.270
Migrant status			
From local	877 (73.1)	Ref	
From other area (i.e., migrant)	323 (26.9)	0.79 (0.68, 0.93)	<0.010
Exposure to any physical violence at baseline			
Not Exposed	1,070 (89.2)	Ref	
Exposed	130 (10.8)	1.16 (0.97, 1.39)	0.110
Mid-upper arm circumference (MUAC)			
Normal	925 (77.1)	Ref	
Malnutrition (MUAC <23cm)	275 (22.9)	1.38 (1.22, 1.58)	<0.001
Household characteristics			
Husband education			
≤ Middle school (≤8 years)	500 (41.7)	Ref	
≥ Secondary school (>8 years)	700 (58.3)	0.95 (0.83, 1.08)	0.400
Family structure			
Nuclear	376 (31.3)	Ref	
Joint/extended/multiple households	824 (68.7)	1.04 (0.91, 1.20)	0.560
Monthly household income (Pakistani Rupee, PKR)			
≤20,000	752 (64.6)	Ref	
>20,000	413 (35.5)	0.90 (0.79, 1.04)	0.150
	Mean (SD)	**RR 95% CI**	**p**
Number of family members, mean (SD)	6.6 (4.1)	1.02 (1.00, 1.03)	0.030

When we examined the association between our social exposures of interest and anemia, having good spousal relationship quality significantly decreased the risk of anemia (Table 3). Specifically, a one-point higher score in the spousal relationship index (indicating a good relationship) was associated with an 13% decreased risk of anemia

(RR=0.87, 95% CI: 0.82, 0.93). This pattern was consistent within the subscales. A one-point increase in emotional and instrumental support subscales (indicating a good spousal relationship) was associated with about a 10% decreased risk of anemia. In contrast, a one-point increase in the conflict/demand subscale (indicating a poor relationship) showed a 10% increased risk of anemia. Social support, either from family (other than the spouse) or friends, was not significantly associated with the risk of anemia.

About 50.4% of women were classified as having financial empowerment. Being financially empowered showed a 1.14 times higher risk of anemia compared to non-empowered women (RR=1.14, 95% CI: 1.01, 1.30). The majority of women (84.3%) reported having household empowerment, but it was not significantly related to anemia (RR=1.02, 95% CI: 0.86, 1.22).

Table 3. Association between social factors and having at least mild anemia in pregnant Pakistani women with at least mild anxiety

Independent Variable		Crude		Adjusted[†]	
	Mean (SD)	RR (95% CI)	p	RR (95% CI)	p
Spousal relationship quality[‡]					
Overall	2.71 (0.88)	0.87 (0.82, 0.92)	<0.001	0.87 (0.82, 0.93)	<0.001
Subscales					
Emotional support	2.70 (0.97)	0.88 (0.83, 0.93)	<0.001	0.90 (0.86, 0.95)	<0.001
Instrumental support	2.51 (1.01)	0.91 (0.86, 0.96)	0.001	0.92 (0.87, 0.98)	0.009
Conflict /demand	1.08 (1.14)	1.10 (1.05, 1.16)	<0.001	1.09 (1.03, 1.15)	0.002
Social support[^]					
Overall	2.10 (1.00)	0.96 (0.91, 1.02)	0.231	0.98 (0.92, 1.04)	0.460
Subscales					
Support from family	2.44 (1.02)	0.98 (0.92, 1.04)	0.449	1.00 (0.94, 1.06)	0.870
Support from friends	1.75 (1.29)	0.97 (0.93, 1.02)	0.210	0.97 (0.93, 1.02)	0.290
	n (%)	RR (95% CI)	p	RR (95% CI)	p
Financial empowerment					
Not empowered	595 (49.6)	Ref		Ref	
Empowered	605 (50.4)	1.11 (0.98, 1.26)	0.098	1.14 (1.01, 1.30)	0.040
Household empowerment					
Not empowered	188 (15.7)	Ref		Ref	
Empowered	1,012 (84.3)	0.98 (0.83, 1.17)	0.849	1.02 (0.86, 1.22)	0.810

[†] Models were adjusted for age, educational level, migrant status, mid-upper arm circumference (MUAC), and number of family members.

[‡] High scores in conflict/demand subscale indicate high levels of conflict or demand. In the overall score, the conflict/demand subscale was reversely scored. High scores in overall relationship quality indicate a good relationship with a spouse.

[^] To prevent overlap with relationship quality with a spouse, we excluded a subscale measuring support from a significant other. This score is an average of two subscales: support from family and support from friends.

DISCUSSION

In this study, we found that spousal relationship quality was significantly associated with anemia. Emotional and instrumental support from the spouse was associated with a reduced risk of anemia, while conflict within the relationship increased the risk. However, anemia did not appear to be

associated with social support from family or friends. Regarding empowerment, financial empowerment had a marginally significant association with anemia, suggesting that empowered women were at a slightly higher risk, while women's household empowerment was not a risk factor. These findings are important because in our study, 45% of pregnant women had at least mild anemia, and our sample primarily consisted of women from lower socio-economic backgrounds who are at risk for food insecurity, which is common in Pakistan (Sunuwar et al., 2020). Anemia prevalence is high in Pakistan, like other countries in South Asia, due to nutritional deficiencies, limited healthcare access, and social factors affecting pregnant women (Mazumder et al., 2023).

The association of the quality of spousal relationships with anemia was one of the most important findings of this study. We found that having a positive marital relationship characterized by emotional and instrumental support was associated with a decreased risk. These findings are consistent with other studies highlighting the importance of spousal support generally in mitigating health risks during pregnancy (Deave et al., 2008). Our results echo those of Triharini et al, which found that emotional support from a spouse can motivate pregnant women to take preventive measures against anemia (Triharini et al., 2023). Spouses are crucial in providing emotional comfort and practical assistance, such as ensuring access to food and healthcare services (Lee et al., 2018). Similarly, a supportive spouse may provide emotional reassurance and the practical means to access iron-rich foods, healthcare services, and prenatal supplements, which are critical in preventing and treating anemia (Allen, 2000).

We also observed that conflicts within the spousal relationship were associated with a higher risk of a pregnant woman's anemia. Poor spousal relationships may increase stress, which could exacerbate anemia by affecting nutritional intake and overall well-being (Kumar et al., 2022). A strained marital relationship may reduce access to both material and emotional resources (Bloom et al., 2001), further compounding the risk of anemia.

While this gender dynamic between spouses has a potential role, we found that social support from family or friends, outside of the spousal relationship, was not significantly associated with anemia in our study. In LMICs like Pakistan, where gender norms often limit women's independence, the role of the spouse in a pregnant woman's health becomes even more critical (Acharya et al., 2010). In many cases, the spouse is the primary gatekeeper of resources in patriarchal households (Rahman et al., 2003), making the quality of the spousal relationship more pivotal to a woman's health outcomes than the quality of relationships with others in her social networks (Kabir et al., 2020). In such contexts, the husband or male family members frequently exert significant control over financial decisions, which can prevent women from accessing adequate healthcare, nutritious food, or prenatal supplements (Pratley, 2016) needed to avoid and manage anemia. Thus, improving marital relationships and addressing gender norms could be critical components in public health strategies aimed at reducing the burden of anemia among pregnant women in LMICs like Pakistan.

Financial empowerment was marginally associated with a higher risk of anemia, which might seem counterintuitive at first glance. One possible explanation could be that financial empowerment, particularly in low-resource settings, may not always

translate into better health outcomes if the financial resources remain limited or inadequate knowledge about nutrition and health (Van Eerdewijk et al., 2017). Women may have financial decision-making power but still lack access to the appropriate healthcare or nutritious food necessary to combat anemia (Pratley, 2016; Carlson et al., 2020). They often prioritize food for their children and husbands over their own needs due to traditional caregiving roles (Ghale et al., 2018). Even women with financial decision-making power may prioritize feeding family members over themselves in food-insecure households (Seligman & Schillinger, 2010). Even when women have financial empowerment, societal norms may limit their ability to use these resources effectively for their well-being (Rahman et al., 2012). In Pakistan and other LMICs, profoundly ingrained gender norms play a crucial role in shaping women's autonomy and access to healthcare (Fikree and Pasha, 2004; Yoshida et al., 2018). Structural barriers, such as limited healthcare access and poor health literacy, could inhibit the full benefits of financial empowerment in these contexts (Pratley, 2016). Previous studies in South Asia have shown that empowerment is not a straightforward determinant of health, as social and structural barriers (such as limited healthcare access and entrenched gender roles) can impede the positive effects of empowerment (Yoshida et al., 2018). In contrast, household empowerment, which refers to the autonomy to make familial decisions, showed no significant relationship with anemia. This may suggest that empowerment in the household, without corresponding financial agency, is insufficient in mitigating anemia risks, a finding that contrasts somewhat with previous research suggesting that empowered women are more likely to secure necessary healthcare (Rahman et al., 2012). Thus, while financial decision-making power is important, it must be accompanied by societal support and structural changes to truly enhance women's health outcomes.

Strengths and limitations in study is focused on pregnant women with anxiety symptoms in a low-resource setting, which is an under-explored population. Our study population also reflects a low-income demographic in a setting with socioeconomic inequalities, where low income, food insecurity, and lack of healthcare access, disproportionately affect women of childbearing age (common in LMICs), making them more vulnerable to conditions like anemia (WHO, 2023). Our findings provide unique insights into the connections between social factors and physical health outcomes such as anemia. We used well-established tools like the Multidimensional Scale of Perceived Social Support (also validated in Urdu) and the MacArthur Relationship Questionnaire to enhance the validity of our findings. However, our study's cross-sectional design limits our ability to establish a causal relationship between social factors and anemia. Our sample was taken from a specific hospital-based setting, so it may not fully represent all pregnant women in Pakistan.

We found that the quality of spousal relationships, especially emotional and practical support from a husband, was associated with anemia risk during pregnancy. Women who reported more supportive relationships had a lower risk of anemia, while those experiencing conflict with their spouse were more likely to be anemic. This pattern suggests that the emotional and material support provided by a spouse may directly or indirectly impact a woman's health during pregnancy. Support from friends or extended family did not

show the same association, possibly because, in many households in Pakistan, the husband is the main decision-maker when it comes to resources like food or healthcare. We also found that financial empowerment had a weak association with increased anemia risk, which may reflect the complicated reality of women having decision-making power but still facing challenges like food insecurity or gendered caregiving roles.

Because anemia remains a major health issue in Pakistan and many similar settings, it's important for future longitudinal research to explore how relationship dynamics and social roles affect health outcomes over time. Nonetheless, our findings suggest the potential value of including family and gender context when designing maternal health programs.

AUTHORS CONTRIBUTION

AM, NS and RL and AM drafted manuscript. SP conducted the analysis and wrote up the results. NA supervised the HMHB intervention. IA supervised the junior researchers in manuscript writing. AZ was in charge of data management and contributed to the manuscript. PJS, AR, conceived of the study idea for the parent study. PJS received grant funding for the study. AM was the local principal investigator of the study and oversaw the data collection in the field and writing of the manuscript. All authors reviewed the manuscript before the final submission.

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CONFLICT OF INTEREST

There are no competing interests to declare.

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