Maternal Psychosocial Stressors, Depression and Its Implications on Maternal and Infant Nutrition: A Longitudinal Birth Cohort Study in South West Ethiopia.

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Dedicated to my wife Sr. Yodit Manaze and our kids:

Rediet Yitbarek
&
Dimetros Yitbarek

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Contributions to Publications

All the articles in this PhD thesis were designed, prepared and published with the knowledge and approval of the main supervisor, **PD. Dr. Veronika Scherbaum**.

Yitbarek Kidane Woldetensay: Conceived, designed, collected, analyzed and interpreted data; draft the manuscripts; and was a corresponding author for all of the publications. The following co-authors were partially involved in the publication of the manuscripts:

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List of Publications

1. **Woldetensay YK**, Belachew T, Tesfaye M, Spielman K, Biesalski HK, Kantelhardt EJ, Scherbaum V. (2018) Validation of the Patient Health Questionnaire (PHQ-9) as a screening tool for depression in pregnant women: Afaan Oromo version. PLoS ONE 13(2): e0191782. https://doi.org/10.1371/journal.pone.0191782

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3. **Woldetensay YK**, Belachew T, Ghosh S, Kantelhardt EJ, Biesalski HK, Scherbaum V. The Effect of Maternal Depressive Symptoms on Infant Feeding Practices in Rural Ethiopia: Community Based Birth Cohort Study [Internet]. In Review; 2019 Dec. Available from: https://www.researchsquare.com/article/76294153-02fa-4682-91cd-5276df8bd609/v1

Summary

This thesis draws on theoretical background and a conceptual model of how selected psychosocial stressors (household food insecurity and intimate partner violence) and coping strategies (maternal social support) are linked to psychological distress (maternal depression) which can influence the nutritional status of mothers and infants. The scientific contribution of this work is threefold. First, it adds to the existing literature on the links between psychosocial stressors, social support and depression, by showing the degree to which household food insecurity and intimate partner violence during pregnancy are associated with the risk of antenatal depressive symptoms, and whether maternal social support plays a buffering role in this process. Second, it describes the longitudinal relationship of prenatal and postnatal depressive symptoms with infant feeding practices. Finally, this work contributes to the literature on depression by validating one of the most commonly applied depression measurement tools, the patient health questionnaire (PHQ-9), in a new culture and language.

This thesis includes three research articles; two were published in peer-reviewed journals and the third manuscript is currently under peer review. The first article is a validation study of the depressive symptoms measurement tool in a new culture and language in a rural setting. The other two papers are based on ENGINE birth cohort data, a prospective community-based birth cohort study conducted by Tufts University in collaboration with Jimma and Hawassa Universities and the Ethiopian Public Health Institute in the southwest part of Ethiopia.

The first article validated an Afaan Oromo language version of the Patient Health Questionnaire (PHQ-9). PHQ-9 is one of the most commonly used depressive symptoms measurement scales. Few validation studies have been conducted in sub-Saharan Africa for scales seeking to detect depression in pregnant women and to the author's knowledge this is the first validation of the PHQ-9 in this language. The main finding of the first paper was that the PHQ-9 scale has acceptable reliability and validity as a screening instrument for depressive symptoms among Afaan Oromo speaking Ethiopian pregnant women. The PHQ-9 score of eight or above was found to be an optimal cut-off point to diagnose prenatal depressive symptoms with a sensitivity and specificity of 80.8% and 79.5% respectively.

The second article tested hypotheses derived from Lazarus and Folkman's stress and coping theory. This theory provides a basis for understanding the impacts of psychosocial stressors on the development and prognosis of depression and the buffering effect of coping mechanisms. The hypotheses are as follows: increased psychosocial stressors, specifically intimate partner violence and household food insecurity during pregnancy, lead to higher prenatal depressive symptoms, and strong social support from friends,

families and partners have a buffering effect. The present results supported these hypotheses by demonstrating that both household food insecurity and intimate partner violence were positively associated with prenatal depressive symptoms. Simultaneously, strong social support from friends, families and partners was negatively associated with prenatal depressive symptoms.

The second article tested another hypothesis that the risk of prenatal depression is higher in anemic pregnant women. The current study supported this hypothesis by demonstrating that anemic pregnant women experienced a higher risk of prenatal depressive symptoms than their non-anemic counterparts. The second paper also investigated the degree to which socio-demographic factors such as age, marital status, educational status, and family size predicted the risk for prenatal depression among pregnant women. The results suggested that unmarried pregnant women and women living in households with large family size were at higher risk of prenatal depressive symptoms.

The third paper tested one hypothesis that infants born to mothers with maternal depressive symptoms (prenatal and postnatal) are more likely to have poor infant feeding practices than their counterparts. The present study findings supported this hypothesis by showing that immediate postnatal depressive symptoms are negatively associated with infant feeding practices. However, there was no association between prenatal depressive symptoms and infant feeding practices. The results also showed that intimate partner violence was negatively associated with infant feeding practices. In this study, strong maternal social support and active social participation were positive predictors of infant feeding practices. Contrary to expectations, the present study also found that household food insecurity and infant morbidity episodes were positively associated with infant feeding practices. Finally, the third article's findings suggested that maternal educational status was positively associated with infant feeding practices and preterm babies were at higher risk of poor infant feeding practices. Infant gender did not affect infant feeding practices in this study.

Overall, this PhD thesis provided support for Lazarus and Folkman's stress and coping theory by demonstrating that psychosocial stressors were positively associated with prenatal depressive symptoms and perceived maternal social support was negatively associated with prenatal depressive symptoms. The thesis also found that anemia during pregnancy is a predictor of prenatal depressive symptoms. Additionally, early postnatal depression and intimate partner violence negatively affect infant feeding practices, whereas perceived maternal social support and active social participation predict appropriate infant feeding practices. The study has a number of implications for practice and future research including prioritization of early screening for maternal depressive symptoms and intimate partner

violence, and promotion of social support and active social participation as a means of preventing maternal depression and improving maternal and infant nutritional status.

Zusammenfassung

Diese Dissertation stützt sich auf theoretische Grundlagen und konzeptionelle Modelle, wie ausgewählte psychosoziale Stressfaktoren (Ernährungsunsicherheit im Haushalt und Gewalt in der Intimpartnerschaft) und Bewältigungsstrategien (soziale Unterstützung von Müttern), die mit psychischen Belastungen (Depression von Müttern) in Verbindung stehen und sich ungünstig auf den Ernährungszustand von Mutter und Kind auswirken können. Der wissenschaftliche Beitrag dieser Arbeit wirkt auf drei Ebenen. Anfangs wurde die vorhandene Literatur zu den Zusammenhängen zwischen psychosozialen Stressfaktoren, sozialer Unterstützung und Depressionen ergänzt, indem aufgezeigt wird, inwieweit Ernährungsunsicherheit im Haushalt und Gewalt in der Partnerschaft während der Schwangerschaft mit dem Risiko vorgeburtlicher depressiver Symptome verbunden sind und ob mütterliche soziale Unterstützung diesen Prozess verringern kann. Zusätzlich wirddie längerfristige Beziehung von pränatalen und postnatalen depressiven Symptomen zu Ernährungspraktiken bei Säuglingen aufgezeigt. Darüber hinaus hat diese Arbeit einen konstruktiven Beitrag zur Erfassung von Depressionen geleistet, indem sie den häufig verwendeten Patientengesundheitsfragebogen (PHQ-9) in einer neuen Kultur und Sprache (Afaan Oromo) validierte.

Die vorliegende Arbeit enthält drei Forschungsartikel; die ersten beiden wurden bereits in begutachteten Fachzeitschriften veröffentlicht und das dritte Manuskript befindet sich noch im Peer-Review-Verfahrens. Der erste Artikel präsentiert eine Validierungsstudie zur Messung depressiver Symptome in einer neuen Kultur und Sprache in ländlicher Umgebung in Äthiopien. Die beiden anderen Studien basieren auf ENGINE-Geburtskohortendaten, einer prospektiven, gemeindenahen Erhebung, die von der Tufts University in Zusammenarbeit mit den Universitäten Jimma und Hawassa sowie dem Ethiopian Public Health Institute im Südwesten Äthiopiens durchgeführt wurden.

Der erste Artikel validierte die Afaan Oromo-Sprachversion des Patientengesundheitsfragebogens (PHQ-9). PHQ-9 ist eine der am häufigsten verwendeten Messskalen für depressive Symptome. In Afrika südlich der Sahara wurden nur wenige Validierungsstudien für Skalen durchgeführt, mit denen Depressionen bei schwangeren Frauen festgestellt werden sollen. Meines Wissens nach ist dies die erste Validierung von PHQ-9 in der SpracheAfaan Oromo. Das wichtigste Ergebnis der ersten Arbeit war,

dass die PHQ-9-Skala als Screening-Instrument für depressive Symptome bei Afaan Oromo-sprechenden schwangeren äthiopischen Frauen eine akzeptable Zuverlässigkeit und Validität aufweist. Der PHQ-9-Score von acht oder mehr wurde als optimaler Grenzwert für die Diagnose pränataler depressiver Symptome mit einer Sensitivität und Spezifität von 80,8% bzw. 79,5% ermittelt.

Der zweite Artikel testete Hypothesen, die aus der Stress- und Bewältigungstheorie von Lazarus und Folkman abgeleitet wurden. Diese Theorie liefert eine Grundlage für das Verständnis der Auswirkungen psychosozialer Stressfaktoren auf die Entwicklung und Prognose von Depressionen und die Pufferwirkung von Bewältigungsmechanismen. Die Hypothesen sind wie folgt: erhöhte psychosoziale Stressfaktoren, insbesondere Gewalt in der Partnerschaft und Ernährungsunsicherheit im Haushalt während der Schwangerschaft führen zu höheren pränatalen depressiven Symptomen. Dagegen wirkt eine starke soziale Unterstützung durch Freunde, Familien und Partner lindernd. Die vorliegenden Ergebnisse untermauern diese Hypothese, indem sie zeigen, dass sowohl Ernährungsunsicherheit im Haushalt als auch Gewalt in der Intimpartnerschaft mit erhöhten pränatalen depressiven Symptomen assoziiert sind. Andererseits stellte eine starke soziale Unterstützung durch Freunde, Familien und Partner einen gewissen Schutz gegen vorgeburtliche depressive Symptome dar.

Im zweiten Artikel wurde auch die Hypothese getestet, ob das Risiko einer pränatalen Depression bei anämischen Schwangeren erhöht ist. Die aktuelle Studie untermauerte diese Hypothese, indem sie zeigte, dass anämische Schwangere im Vergleich zu nicht anämisch schwangeren Frauen ein höheres Risiko für pränatale depressive Symptome aufwiesen. Zusätzlich wurde untersucht, inwieweit der soziodemografische Status schwangerer Frauen wie Alter, Familienstand, Bildungsstand, und Familiengröße das Risiko für eine pränatale Depression prognostiziert. Die Ergebnisse zeigten, dass unverheiratete Schwangere und Frauen, die in Haushalten einer Großfamilie leben, einem höheren Risiko für pränatale depressive Symptome ausgesetzt waren.

Im dritten Manuskript wurde die Hypothese geprüft, ob Säuglinge, die von Müttern mit depressiven Symptomen (vor und nach der Geburt) geboren wurden, mit höherer Wahrscheinlichkeit unzureichenden Ernährungspraktiken ausgesetzt sind im Vergleich zu Säuglingen deren Mütter nicht unter Depressionen litten. Die Ergebnisse der vorliegenden Studie unterstützen diese Hypothese, indem sie zeigen, dass unmittelbare postnatale depressive Symptome verstärkt zu inadäquaten

Ernährungspraktiken bei Säuglingen führen. Es gab jedoch keinen Zusammenhang zwischen pränatalen depressiven Symptomen und Säuglingsernährungspraktiken. Die Ergebnisse zeigten auch, dass sich Gewalt in der Partnerschaft negativ auf die Ernährung von Säuglingen auswirkt. Eine starke soziale Unterstützung der Mütter und eine aktive soziale Beteiligung stellen positive Prädiktoren für Säuglingsernährungspraktiken dar. Auch wurde festgestellt, dass Haushaltsnahrungsunsicherheit und Säuglingskrankheiten positiv mit günstigen Ernährungspraktiken von Säuglingen assoziiert sind, sehr wahrscheinlich bedingt durch Kompensationsmechanismen. Die Ergebnisse des dritten Artikels zeigten auch, dass sich ein hoher mütterlicher Bildungsstatus positiv aufdie Ernährung von Säuglingen auswirkt. Frühgeborene hingegenscheinen einem höheren Risiko für inadäquate Ernährungsweisenausgeliefert zu sein. Das Geschlecht des Kindes hatte in dieser Studie keinen Einfluss auf die Säuglingsernährungspraktiken.

Insgesamt lieferte diese Dissertation eine Unterstützung für die Stress- und Bewältigungstheorie von Lazarus und Folkman, indem gezeigt wurde, dass psychosoziale Stressfaktoren pränatale depressive Symptome verstärken, während wahrgenommene mütterliche soziale Unterstützung sich lindernd auf pränatale depressive Symptomeauswirkt. Die Arbeit zeigte auch, dass Anämie während der Schwangerschaft zusätzlich einen Prädiktor für pränatale depressive Symptome darstellt. Darüber hinaus wirken sich frühe postnatale Depressionen und Gewalt gegen den Intimpartner negativ auf die Ernährungspraktiken für Säuglinge aus, wohingegen die wahrgenommene soziale Unterstützung der Mütter und ihre aktive soziale Beteiligung eine positive Prognose für angemessene Säuglingsernährungspraktiken darstellen. Die vorliegende Studie hat viele Implikationen für die Praxis und zukünftige Forschungen, einschließlich der Priorisierung des frühen Screenings von depressiven Symptomen bei Müttern und die Vermeidung von Gewalt in der Intimpartnerschaft sowie die Förderung der sozialen Unterstützung und aktiven sozialen Beteiligung als Mittel zur Vorbeugung von Depressionen bei Müttern und zur Verbesserung des Ernährungszustandes von Müttern und Säuglingen.

List of Abbreviations

ANC	Antenatal Care
CI	Confidence Interval
DSM-IV	Diagnostic and Statistical Manual- IV
EDHS	Ethiopian Demographic and health Survey
ENGINE	Empowering New Generation to Improve Nutrition and Economic Opportunities
EPDS	Edinburgh Postpartum Depression Scale
FAO	Food and Agriculture Organization
HEW	Health Extension Workers
HIC	High-income countries
HITS	Hurt, Insult, Threaten and Scream
HPA	Hypothalamic-Pituitary-Adrenocortical
ICD	International Classification of Disease
ICFI	Infant and Child Feeding index
IFP	Infant Feeding Practice
IPV	Intimate Partner Violence
IRB	Institutional Review Board
IYCF	Infant and Young Child Feeding
LMIC	Lower-Middle-Income Countries
MSS	Maternal Social support
MDD	Major depressive disorder
MUAC	Mid upper arm circumference
ODK	Open Data Kit
OR	Odds Ratio
PHQ-9	Patient health questionnaire-9
PUFA	Polyunsaturated Fatty Acids
SDG	Sustainable Development Goal
SNNPR	Southern Nations Nationalities and Peoples Region
SPSS	Statistical Package for the Social Sciences
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization
YLD	Years Lost due to Disability

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Chapter 1

General Introduction

1.1. Introduction

The importance of mental health has long been recognized by the World Health Organization (1) and was reaffirmed again with the Declaration of Alma-Ata in 1978 when primary healthcare for all was declared (2). The World Health Organization (WHO) considered mental health from its inception by including mental well-being in its core health definition "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (3,4). This definition of health shows that mental health is an integral part of health, mental health is more than the absence of mental illness, and mental health is intimately connected with physical health and behavior (5). WHO has defined mental health as "a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community (6).

Mental disorder has adverse health and economic consequences (7). It is responsible worldwide for 32% of years of disability and 13% of disability adjusted life years (8). In addition, persons with these disorders face increased rates of morbidity from general medical conditions (9–11) and a higher risk of premature mortality(12). The health consequences are more pronounced during pregnancy and postpartum period as it affects both the mother and her offspring (13–16). Mental disorder also has profound economic consequences. As studies shown, in Ethiopia, people with severe mental disorders are more likely to be unemployed (17) and experience more household food insecurity than the general population (18). Financial difficulty is the main mental health disorder burden for three fourth of caretakers in Ethiopia (19).

Although, mental health is crucial to the overall well-being of individuals, societies and countries; unfortunately, in most parts of the world, mental health and mental disorders are not accorded anywhere the same importance as physical health. Rather, they have been largely ignored or neglected (20). For the first time, world leaders recognized the promotion of mental health and well-being as health priorities within the global development agenda by including the topic in the sustainable development goal (SDG) in 2015 (21). It is believed that improving mental health supports the efforts to reach all SDGs and progress towards the 17 SDG goals also impact mental health. Especially, SDG 3.4, 3.5 and other SDGs relating to poverty reduction, gender, economic development and reducing inequalities require mental health attention as mental disorders are associated with those psychosocial factors (22). More importantly, these psychosocial factors are more common in women (23).

Psychosocial stressor is a major life influencing event that leads to intense stress so profound that it can contribute to the development or aggravation of an existing psychological disorder(24). Among the stressors this dissertation mainly focuses on household food insecurity and intimate partner violence during pregnancy and postpartum and explored its association with prenatal and postnatal depressive symptoms and with infant feeding practices. As social supports could play a protective role against many of the mental disorders, the dissertation also examined the role of perceived social support on prenatal depressive symptoms and infant feeding practices.

The dissertation is organized as follows: In **Chapters I**, detailed information on state of the art about prenatal and postnatal depressive symptoms, including its prevalence, association and mechanisms of pathway with household food insecurity, intimate partner violence, prenatal anaemia, and perceived social support are discussed. Besides, synthesis of infant feeding practices and its psychosocial determinants are presented. Relevance of the topic, theoretical framework of the study, hypotheses and objectives of the thesis are also presented in this chapter. In **chapter II**, the general methods and materials employed in the conduct of this thesis including detailed information about the study setting are explained. **Chapter III** presents validation of Afaan Oromo Version of the patient health questionnaire (PHQ-9) as a screening tool for depression in pregnant women. **Chapter IV** demonstrates the effects of psychosocial stressors on prenatal depressive symptoms and the buffering role of perceived social support against prenatal depressive symptoms. **Chapter V** presents the effect of maternal depressive symptoms (prenatal and postnatal) and selected psychosocial stressors on infant feeding practices. In **chapter VI**, the findings from the various studies in this thesis are synthesized and in **Chapter VII** conclusion and potential implications of the study forwarded.

1.2. Background

1.2.1. Prenatal and Postnatal Depression

Depression is a mental disorder presented with at least two weeks of persistent low mood accompanied by loss of interest in normally enjoyable activities, low energy, and reduced concentration and general capacity(25). Other symptoms such as changes in sleep patterns, appetite, physical, and mental fatigue are also very common. Depression is the leading cause of mental health disorder globally, affecting an estimated 300 million people worldwide with total estimated number of people having depression increased by 18% between 2005 and 2015 (26). It is also the leading cause of disability worldwide, and is a major contributor to the overall global burden of disease (27).

Depression prevalence varies by different sociodemographic variables including age and sex. Women are more likely to suffer from major depressive disorders than men (28). Prevalence report also varies by type of depression measurement tool applied (29). Okagbue and colleagues in their recent work systematically reviewed 26 research articles on antenatal depression and found that those 26 articles utilized a total of 16 different depression measurement tools with significantly high variation in prevalence of antenatal depression reported (29). In general, use of self-reported screening questionnaires rather than validated diagnostic interviews is an obstacle in estimating depression prevalence accurately; use of such instruments is known to exaggerate rates substantially and blurs distinctions between low- and high-prevalence groups (30).

According to WHO, globally about 10% of pregnant women and 13% of women in the immediate postpartum period experience a mental disorder; primarily depression. A literature review in 2012 on prevalence and determinants of common perinatal mental health disorders by Fisher et al. revealed that only 8% of low and lower-middle-income countries (LMIC) have available data on the antenatal prevalence of common mental disorders, with most of this literature published after 2002 (31). Furthermore, in nearly all studies, recruitment occurred during antenatal visits at a health facility, which precludes generalizability to women who do not have access to antenatal services. The limited evidence for LMIC, however, indicates that average prevalence is higher than in high-income countries (HIC) (32). Gelaye and colleagues found that the prevalence of antenatal and postnatal depression among women in LMIC is 25.3% and 19.0% respectively, compared to 10% perinatal prevalence among women in HIC.

A recent meta-analysis of five articles in Ethiopia reported a pooled antenatal depression prevalence of 21.3% (95% CI; 16.0–27.8) with significant heterogeneity among the five studies included (33). In this systematic review the prevalence of depression was highest during the third (32%) than the first (19%) trimesters of pregnancy.

The postpartum period is a challenging transition time for a mother (34) with two fold higher risk of depression than the other periods (35). According to the International Classification of Disease (ICD), postnatal depression is depression occurring within six weeks postpartum(36). It is one of the most common causes of maternal distress which adversely affects the mother, her baby and her whole family (37,38). Its specific causes are unclear; however, researchers suggested psychosocial stressors (39,40) and biological factors (41) as main causes. Mothers with depression during the postpartum period are hostile, negligent, and less responsive to infants need and have low tolerance (42). Such a behavior adversely affects mother-infant bonding and reduces breastfeeding (43) and impairs the mental and physical development of the child (38,42).

Postpartum depression often go undetected (44). According to WHO, about 13% of women in the immediate postpartum period experience a mental disorder, primarily depression globally. The prevalence is even higher in developing countries; 19.8% (45). Epidemiological studies showed that the estimated prevalence of postnatal depression varies between studies, countries and depending on measurement instrument. A recent systematic review assessing 124 articles from 50 countries around the globe revealed that overall the prevalence of postnatal depression ranges from 4.0% to 63.9%, with Japan and America recording the lowest and highest rates of postnatal depression, respectively (46). A wide variation in reported prevalence was also observed within continents; in Africa the prevalence ranges from 7.2% to 50.3%. In Ethiopia, researches published in 2018 and 2019 reported that prevalence of postnatal depression ranges from 12.2% to 33.8% (47–53).

1.2.2. Nutrition, Household Food Insecurity and Depression

The development of mental disorders, such as depression, is affected by different factors including physiological, social, genetic, psychological and environmental factors (54). Several authors reported nutrition as one of the key modifiable risk factor in the development and pathogenesis of depression (55–64). Our brain needs a continuous supply of nutrients including amino acids, lipids, vitamins, minerals and trace elements (65). Previous studies have shown that nutritional deficiencies have a role in the pathogenesis of depression and other mental disorders (66–68).

The exact mechanisms of action of nutrition on depression are currently being widely investigated. Recent evidences suggested that the possible linking factor between diet and depression is the gut microbiota via the gut-brain axis (69). As shown in Figure 1 below, the gut-brain axis is a bidirectional link between the central nervous system and the enteric nervous system of the body (70). Previous studies have shown that diet affects the composition of the gut microbiota (71,72) and gut microbiota influences the level of tryptophan (73,74). Tryptophan is a precursor of serotonin (75). Serotonin and its receptors in the brain have a role in the development of depression (76,77).

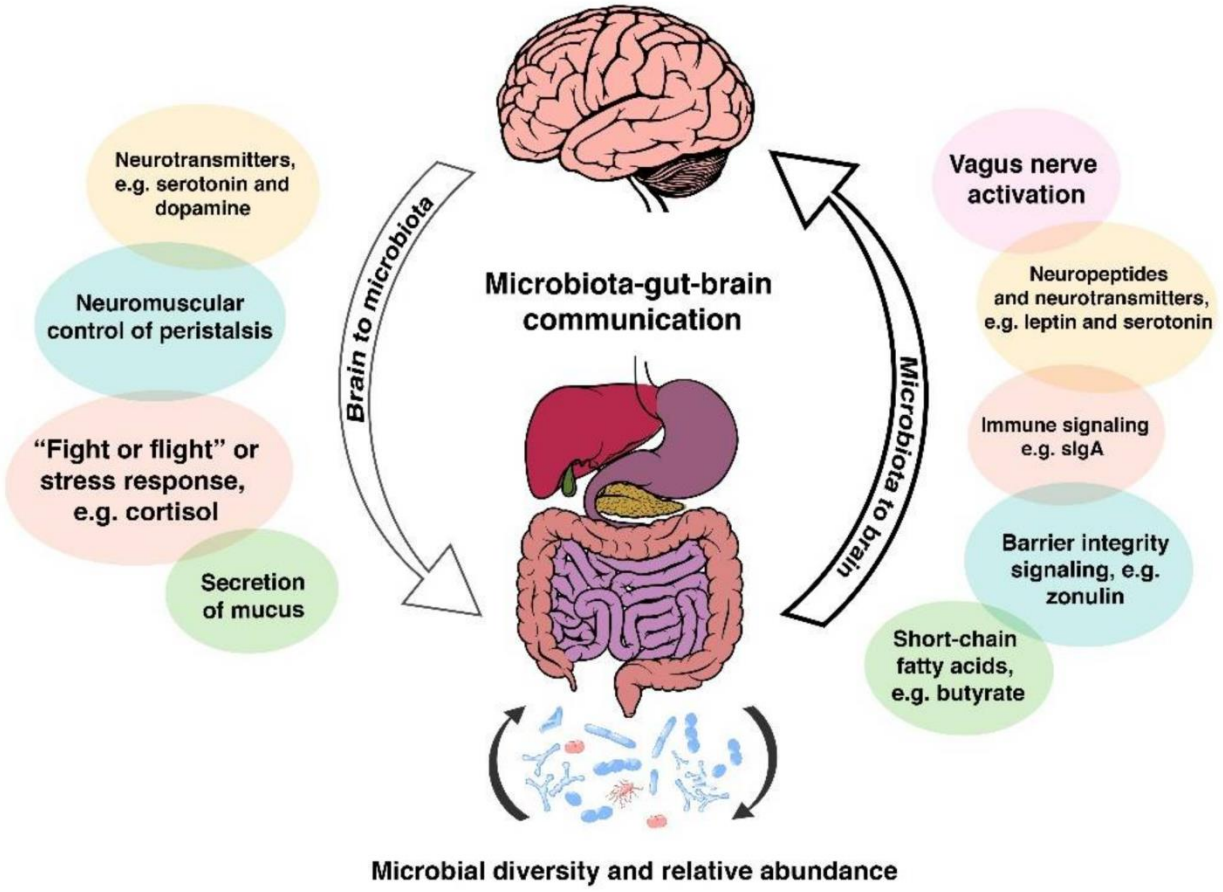

Figure 1: Microbiome gut-brain axis structure

Adapted with permission from: Miguel 2018

Accessed: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4367209/

In recent years, the number of studies exploring the link between quality of our diet and mental health was increasing swiftly. Dietary factors play either by aggravating or improving the symptoms and progression of depression. For example, high quality diet has been uniquely associated with a lower risk of depression (78–80). Specific nutrients such as Polyunsaturated fatty acids (PUFAs), especially omega-3

FAs, phospholipids, cholesterol, niacin, folate, vitamin B6, vitamin B12, and vitamin D have a beneficial effect on mental health (81–84). On the contrary, saturated fat and simple sugar can be hazardous for brain health, increasing the risk for mental illnesses (85). These nutrients have been linked to causation as well as severity of depression, thus correction of these deficiencies can play a significant role in prevention as well as treatment of depression (86,87).

1.2.2.1. Depression and anaemia during pregnancy and postpartum

Anaemia is the most common nutritional deficiency presented with fatigue, weakness, dizziness and drowsiness(88). According to WHO, iron deficiency is the most common cause of anaemia globally(89). Pregnant women and children are particularly vulnerable for anaemia due to additional physiological demands on the mother. During pregnancy, anemia is defined as a condition in which the hemoglobin concentration of a woman is <11 g/dl (90). Anemia affects 46% of pregnant women in developing countries and contributes to maternal mortality and low birth weight(88). Research has shown that anaemia was associated with prenatal (91–93) and postpartum depression (94). For example, a cohort study in West Wales shows that depression was associated with anaemia in women before and after birth (95). However, a study in China reported no association between anaemia and postpartum depression (96).

1.2.2.2. Household Food Insecurity and Depression

Food insecurity is a "limited or uncertain availability of nutritionally adequate and safe foods or the inability to acquire acceptable foods in socially acceptable ways," (97). According to the three most recent editions of *Food Security and Nutrition in the World* report, hunger and food insecurity was on the rise at global level and east African countries are the most affected with more than 64% of their population are moderately or severely food insecure (98). Ethiopia's food insecurity status was not included in the recent *Food Security and Nutrition in the World* 2019 report. Ethiopian Statistics Agency and World Food Program in their comprehensive food security and vulnerability analysis from 30,229 households recently reported that in 2016 about 21% of households in Ethiopia were food insecure (99). However, epidemiological pocket studies published in 2019 reported that household food insecurity in Ethiopia ranges from 54% to 72% (100–103). Five years individual level food insecurity FAO data indicated that in all continents the prevalence of food insecurity is slightly higher in women than men (98). This gender difference may depend on gender related norms in the community. For example in sub-Saharan Africa, where food insecurity is the highest, food preparation and serving is commonly women's responsibility (104).

Food insecurity is a powerful stressor (105–107) having potentially negative consequences on mental, social and physical well-being. Several previous researchers show that household food insecurity has strong links with poor physical health (108–110) and those living in food insecure households with chronic health problems experienced increased difficulties managing those physical health conditions (111,112). The association between household food insecurity and mental disorders (such as depression) has been reported by several previous researches globally (113–119). Studies in Ethiopia during the lean season (June & July) showed that women reporting food insecurity are five times as likely as food secure women to report depressive symptoms during pregnancy (120).

Household food insecurity influence mental health through different pathways: Food insecurity creates uncertainty over the ability to maintain food supplies, or to acquire sufficient food in the future and in this way it can provoke a stress response and causes anxiety and depression (121,122). Moreover, acquiring foods in socially unacceptable ways can induce feelings of alienation, powerlessness, shame, and guilt that are associated with depression (123–125). By magnifying the socioeconomic disparities, food insecurity has also the potential to increase cultural sensitivities and influence overall mental well-being (126). The association between food insecurity and mental health has a vicious cycle, whereby mental disorder could increase vulnerability to poverty and food insecurity as a result of increased health expenses, lost employment or other business, poor social support and stigma. On the other hand, food insecurity and poverty increases the risk of mental disorder as a result of reduced social capital, social exclusion, violence and trauma, and poor access to health (127–129). Besides, managing a food insecure household is extremely difficult and is a stressor by itself (130).

From the literature it become clear that food insecurity and depression shared one common feature in that the prevalence of both food insecurity (98) and depression (131–133) are higher among women than men. Similarly, the association between food insecurity and depression is stronger in women than men (134–137). Women have strong connection with food insecurity as they are most responsible for feeding the family, purchasing and preparing healthy food. Food insecurity can be considered as a gender issue as women face various barriers to accessing food including their role in feeding the family and the costs of purchasing and preparing healthy food (138). Though gender related norms are one possible reason for the stronger association between food insecurity and depression in women (104), the reason for higher prevalence of depression among women than men are yet unknown.

Researchers exploring how and why there is gender difference in depression prevalence come up with different conclusions. Eaton and colleagues concluded that the underlying structure of common mental disorders was gender invariant with significant gender differences in mean liability levels and hence the observed gender differences originate at the level of latent internalizing and externalizing liabilities (139). Whereas Alber (2015) concluded that biological factors, such as the variation in ovarian hormone levels and particularly decreases in estrogen, may contribute to the increased prevalence of depression and anxiety in women (140). A recent study in Canada found that the well-documented sex gap in mental health outcomes was reduced to non-significance when household food insecurity was reported. The authors concluded that household food insecurity is a chronic stressor that devastates males capacity to either withstand reporting mental health status or succumb to them(117).

There are only limited studies exploring the effect of household food insecurity on depression during pregnancy and postpartum. The limited studies, however, showed that household food insecurity was positively associated with prenatal (141–143) and postnatal depression (134,144,145).

1.2.2.3. Intimate partner violence and Prenatal Depression

Violence against women is a public health problem and violation of human rights that is rooted in gender inequality (146,147). Intimate partner violence (IPV) is the most common form of violence against women worldwide (148). It is domestic violence by a current or former spouse or partner in an intimate relationship against the other spouse or partner (149,150). The violence includes acts of physical aggression, psychological abuse, moral abuse, forced sexual intercourse or any other controlling behavior (151). Although both women and men can be victims and perpetrators of IPV (152), women's use of physical violence was more likely motivated by self-defense or fear whereas men's use of violence was motivated by control (153). Previous studies reported that the majority of IPV is inflicted upon women (154), women are more likely to suffer injuries as a result (155) and more severe perpetration and domestic battery are committed by men (156,157). Highest proportion of women experience violence from their partners (158,159).

Although, the prevalence of IPV is difficult to estimate due to a variety of reasons including incompatible data collection techniques and tools, non-representative sampling techniques and socio-cultural barriers to identifying and disclosing IPV (160), existing studies show that nearly a third of women around the world experience at least one type of IPV at least once in their life time (147). The prevalence is much worse in low income countries (161). In Ethiopia more than half of women experience violence from

their intimate partners at least once in their life time (159,162,163). The recent Ethiopian Demographic and health Survey (EDHS) reported that 34% of ever-married women aged 15-49 years have experienced spouse physical, sexual or emotional violence (164).

Intimate partner violence is quite common during pregnancy and postpartum which makes it of particular concern due to its consequences to herself, the fetus' and later to child's health and nutritional status(165,166). A meta-analysis by James and colleagues reported that depending on the definition, assessment tools and population the prevalence of IPV during pregnancy ranges from 4.8 to 63.4% (167). A recent meta –analysis in Ethiopia (168) reported the prevalence of IPV during pregnancy was 26.1% (range 12.0-44.7%) which is much higher than the 15.2% pooled prevalence of the meta-analysis report among pregnant women in African countries (169). The postpartum period is also considered a time of increased risk of IPV (170) particularly for new mothers (171,172).

IPV affects women's physical and mental health through direct (eg. injury) and indirect (such as chronic health problems that arise from prolonged stress) pathways. Research has shown that women who suffer from IPV are less likely to use maternity health services than their unaffected counterparts (173,174). Likewise, IPV causes extensive mental health consequences among its victims (175,176). IPV is a stressor for many women (25) and significantly contributes to the occurrence of mental disorders during pregnancy (34). A growing number of studies have demonstrated that IPV victimization is associated with prenatal (177,178) and postnatal depression (179–182). Fear and learned helplessness are the most common reasons for IPV to generates adverse mental health consequences including depression (183,184). Because of fear of stigmatization, IPV victims often experience feelings of shame, isolation and entrapment and did not communicate openly to others that violence occurred to them by their spouses (184). This results in lack of support from friends and families and rather leads to more depression.

Furthermore, IPV victims face economical and social crisis (185). Poverty is one of the key contributors to intimate partner violence (186). Since poverty is inherently stressful, it has been argued that intimate partner violence may result from stress and that poorer men have fewer resources to reduce stress. Poverty as it impairs purchasing power, results in household food insecurity. IPV may affect the couple's capacity to organize the home environment and manage the resources available in order to guarantee the food and nutrition security of the family. Looking at this link from household food insecurity side, a broader anthropological conceptualization of food insecurity posits that acute or chronic exposure to periods of food uncertainty can influence mental and physical health outcomes. Social support plays a

buffering role for both depressive symptoms and IPV. Social support from family or friends buffers the effects of environmental stressors such as IPV and poverty and could decrease individual's vulnerability to depression (187).

1.2.3. Social Support & Depression during Pregnancy

Social support refers to receiving voluntary assistance promoting a positive response from family, friends, spouse or other people (188,189). One can receive social support in the form of physical, emotional (sympathy, love, and care), verbal, and financial (190). Social support is the functional content of relationships that can be categorized into four broad types of supportive behaviors or acts: Emotional support (provision of empathy, love, trust, and caring), instrumental support (provision of tangible aid and services that directly assist a person in need), informational support (provision of advice, suggestions, and information that a person can use to address problems) and appraisal support (provision of information that is useful for self-evaluation purposes—in other words, constructive feedback and affirmation) (191). Although these four types of support can be differentiated conceptually, relationships that provide one type often also provide other types, thus making it difficult to study them empirically as separate constructs (191).

Scholars also categorize social support as structural and functional type (192). Structural support refers to the individual's integration in the social context whereas functional support reflects the content of social interaction in terms of the amount and types of provision that comes from social relationships (193). Structural support can be measured by considering the number and frequency of social contacts, as well as participation and engagement in organizations and networks. On the other hand, functional support can be measured as received or perceived by the receiver, where the latter has been more consistently linked to health outcomes (194). Barrera also classified social support as social embeddedness, enacted support and perceived social support (195).

Social embeddedness refers to the connections that individuals have to significant others in their social environments. This category of social support can be measured either using broad indicators of the presence of social ties such as marital status or using social network analysis. Enacted support refers to actual received support; including any received support, be it emotional, tangible, or informational support. Finally, perceived support refers to satisfaction with support exchanges and anticipated support. This concept fits cognitive models of stress and coping processes that emphasize the appraisal of potentially threatening situations and resources that can be enlisted in coping efforts (196). Perceived availability and adequacy of support ties are two basic dimensions incorporated in perceived social

support measurements. However, unlike social embeddedness it doesn't quantify the number of supporters or the amount of social contacts (195).

Important advances have been made in social support research since 1974 and literature reviews have already shown an impressive accumulation of studies on the relationship of social support with physical illness and psychological disorders (195). Many authors reported negative association between social support and depressive symptoms during pregnancy (197–201) and postpartum (202,203). However, majority of studies were cross-sectional by design making inferences about causality difficult and the causal direction is unclear. Advancing the understanding of the association between social support and depressive symptoms requires studies based on longitudinal data (204).

1.2.4. Infant Feeding Practices and Maternal Depression

According to recent WHO reports, significant global progress has been made in reducing child mortality since 1990 (205). The global under-5 mortality rate has dropped by 59%between 1990 and 2018. However, there are still disparities in under-5 mortality across regions and countries. Sub-Saharan Africa remains the region with the highest rate in the world. Half of all under-five deaths in 2018 occurred in just five countries: India, Nigeria, Pakistan, Ethiopia and the Democratic Republic of the Congo. Nutrition-related factors contribute to about 45% of deaths in children under-5 years of age (205).Recently, United Nations Children's Fund (UNICEF) reported that malnutrition hampered growth of more than one third of children globally and over half of the children suffer from hidden hunger due to deficiencies in essential nutrients (206).

Nutritional deficits during the first 2 years of life causes stunting, which results in the adult being shorter than his or her potential height (207). Adults who were malnourished in early childhood have been found to have several deficits including impaired intellectual performance, delayed childhood development, reduced capacity for physical work, reduced reproductive capacity and more complicated deliveries in women including low birth weight(208–212). Maternal malnutrition has intergenerational linkage with the health and survival of her offspring(213,214). Hence, if nutritional deficits left unintervened during the first two years of life, the cycle continues. The first two years of life is a critical window of opportunity for breaking this cycle by prevention of growth faltering and undernutrition through prevention of low birth weight and providing appropriate IFPs (215).

Appropriate infant and young child feeding (IYCF) practices in children 0–23 months of age is among the most effective and critical interventions to improved nutrition, health and development of children(216,217). WHO and UNICEF set a global strategy for optimal IYCF in 2003(218) and Ministry

of Health of Ethiopia has also developed and implemented the IYCF guidelines in 2004 (219). However, IYCF practices are still suboptimal in Ethiopia and elsewhere (220,221,164,222–224).

According to social cognitive theory(225), factors influencing IFPs can be broadly categorized into two categories: internal personal and socio-environmental factors. Internal personal factors include cognitive/affective (knowledge, attitudes and beliefs), outcome expectations (best for infant), self-efficacy (confidence and previous experience), biological (for example mothers age) or psychosocial (comfort with breastfeeding in public). Socio-environmental factors include institutional (health care practice, policy etc.), social (family support/dynamics), socio-demographic (education, income ethnicity), physical (fatigue, pain etc.) and others (cost, availability and the like). Several previous studies focused on exploring those associations(226–229). There are limited literature suggesting that maternal depression could lead to poor infant feeding practices, consequently leading to malnutrition and reduced physical growth (230–232). The results of the limited literature available examining the associations between maternal depressive symptoms and infant feeding practices are mixed.

Systematic reviews in 2019 and 2015concluded that depressed women exclusively breastfed their children for shorter duration than non-depressed women(230,233). Other previous studies also reported a negative association between maternal postnatal depression and early initiation of breastfeeding (234), complementary feeding initiation (235) and infants' dietary diversity (236,237). On the contrary, a recent community based study in Ghana reported that maternal depression was not associated with complementary feeding indicators in younger children of 6-23 months (238). Studies also shown that prenatal depressive symptoms are associated with infant feeding derivatives such as early breastfeeding initiation (239), exclusive breastfeeding (240), breastfeeding duration (241), and timely initiation of complementary feeding. However, in the present study there was no statistically significant association between prenatal depressive symptoms and total IFPs score but with specific IFP components particularly with early breastfeeding initiation and minimum meal frequency.

1.3. Relevance of the topic

The background section highlighted a number of limitations to the maternal mental health research as it has been conducted to date. Specifically, in low and middle-income countries such as Ethiopia, there is a scarcity of mental health research. At the time this thesis was initiated, there were very few or no published articles that described intimate partner violence and household food insecurity as a stressor during pregnancy, or examined their association with maternal depression and its consequences on maternal and infant nutritional practices. Furthermore, the limited research available was conceptually and methodologically inconsistent (33,242).

The limited studies indicated that in Ethiopia, mental illness is the highest-burden non-communicable disorder; in 2017 depression ranked second out of all causes of years lived with disability (YLD) in the country (243). The burden of depression in Ethiopia is estimated to have increased by 34.2% between 2007 and 2017 (243). Recent systematic reviews on prevalence and determinants of prenatal depression in Ethiopia reported that the prevalence of prenatal depression is as high as 25.3% (33,242) and postnatal depression prevalence was even higher; as high as 33.8% (47–53). However, most of these findings come from facility-based studies recruiting participants during antenatal or postnatal care visits; which potentially excludes women who do not seek antenatal and postnatal care follow-up, making generalizability difficult.

Maternal mental health is a significant concern as it involves the dual vulnerability of both mothers and their infants. Maternal depression in resource-constrained settings is linked directly to lower infant birth weight, higher rates of malnutrition and stunting, higher rates of diarrhoeal disease, infectious illness and hospital admission and reduced completion of recommended schedules of immunization in children. It also adversely affects the physical, cognitive, social, behavioral and emotional development of children (244). If the ability of women to care for their infants and young children, including appropriate feeding practices, is compromised, the survival and development of the children is also jeopardized.

Similarly, the relationship between maternal depression and the psychosocial stressors of household food insecurity and intimate partner violence, especially during pregnancy and postpartum, have not been adequately studied, despite being highly prevalent in the country. Recent studies have suggested that 54% to 72% of Ethiopians report household food insecurity (100–103), and the prevalence of reported food insecurity is higher among women than men (98). Similarly, in Ethiopia more than half of

women experience violence from their intimate partners at least once in their lifetime (159,162,163). There is currently much debate over the safety and effectiveness of antidepressants for treatment of depression(244), and identification of modifiable risk factors for depression could suggest which risk factors could potentially be most effectively targeted for prevention interventions (245,246). In this case the present study could contribute to this identification of modifiable risk factors for maternal depression.

Guided by Lazarus and Folkman's theory of stress and coping (196) and using a longitudinal prospective cohort study design, this dissertation was initiated to help better understand whether selected psychosocial stressors (household food insecurity and intimate partner violence) are linked to prenatal depression, to test the buffering role of perceived social support during pregnancy, and to explore the effect of maternal depressive symptoms and associated psychosocial stressors on infant feeding practices. An improved understanding of these relationships may assist mental health and other professionals to better advocate for policies which may help reduce those identified risk factors, and hence reduce the prevalence of maternal depression and thus improve infant feeding practices.

1.4. Theoretical framework

Neuman and Laurence nicely state the importance of using theory in research work:

> *"Researchers who attempt to proceed without theory or fail to make it explicit may waste time collecting useless data. They easily fall into the trap of hazy and vague thinking, faulty logic, and imprecise concepts. They may find it difficult to converge onto a crisp research issue or to generate a lucid account of their study's purpose. Theory frames how we look at and think about a topic. It gives us concepts, provides basic assumptions, directs us to the important questions, and suggests ways for us to make sense of data. Theory enables us to connect a single study to the immense base of knowledge to which other researchers contribute"*(247).

Reflecting this quotation, this thesis was largely guided by Lazarus and Folkman's theory of stress and coping (196).

As highlighted in chapter 1, several studies report a positive association between maternal depression and intimate partner violence (177,178), maternal depression and nutrition particularly maternal anaemia (91–93) and household food insecurity (113–119). Previous studies have also reported an inverse association between maternal depression and social support (197–201) and maternal depression and social participation (248). Moreover, an inverse association between maternal depression and infant

feeding practices has been reported by a variety of studies (249,234,237,250,251,235). On the theoretical level, such a relationship between stressors (intimate partner violence, household food insecurity etc.), coping mechanisms/buffers (for social support), and stress outcomes (depression, anxiety and nervousness) is explained by Lazarus and Folkman's theory (196).

At a very general level, stress theories can be divided into three major and quite distinct approaches: stimulus-oriented, response-oriented, and interactional theories (252). The **stimulus-oriented theories** define stress as external stimuli that may increase the demand of the individual (stressors). The main focus of the stimulus-oriented theories is the number and amount of external stressors encountered. **Response-oriented theories**, on the other hand, define stress as the mental and bodily reaction generated by stressful stimuli (252). Such reactions may include neurobiological, physical, as well as psychological (such as anxiety, nervousness and/or depression) changes. However, Lazarus and colleagues argued that neither the stimulus- nor the response-oriented approaches succeed in explaining the stress experience. The stimulus-oriented approach fails to explain why and how we respond differently to an external stimulus, which makes the stimulus alone insufficient to define stress (253). And the response-oriented approach does not provide any important additional information beyond that of the stimulus-approach because it is built on circular reasoning, in which the stressor is defined by the fact that it leads to a stress response, while the stress response, in turn, is defined in reference back to the stressor (253).

By emphasizing the individual as an important mediator between external stressors and the resulting stress response, the **interactional theories** provide a newer approach to stress research (252). The interactional theories emphasize the importance of taking individual differences and coping strategies into consideration when measuring stress. Each individual has different capacities and strategies for managing stressful situations, and the same external stressor may therefore result in different levels of stress depending on the individual's mental attitude and personal resources (254). External resources such as strong social support seem to greatly influence the way the individual adapts to and resolves an encounter with a stressful situation (20).

Previous empirical findings suggest that maternal depression is positively associated with a restrictive feeding style (255–257) and with inappropriate child feeding practices (230,234–237). Moreover, a number of studies have indicated that socio-demographic factors are associated with stressors, maternal depression (258–261), and infant feeding practices (221,234,236) and in the present study these are treated as confounder variables and are included in all models.

This thesis was based on the three theories explained above. Here stress was conceived as a person-environment transaction where the stressor (intimate partner violence and household food insecurity) creates a threat, maternal perceived social support and social participation serve as coping mechanisms, and maternal depressive symptoms represent the person's response to the threat. In this model the assumption is that greater maternal exposure to objectively stressful events results in increased manifestation of maternal depressive symptoms. The effect is moderated by coping resources, such as adequate maternal social support and active participation in social groups. Figure I illustrates how the stress theories discussed above are organized into a conceptual framework linking stress with maternal and infant nutritional outcomes.

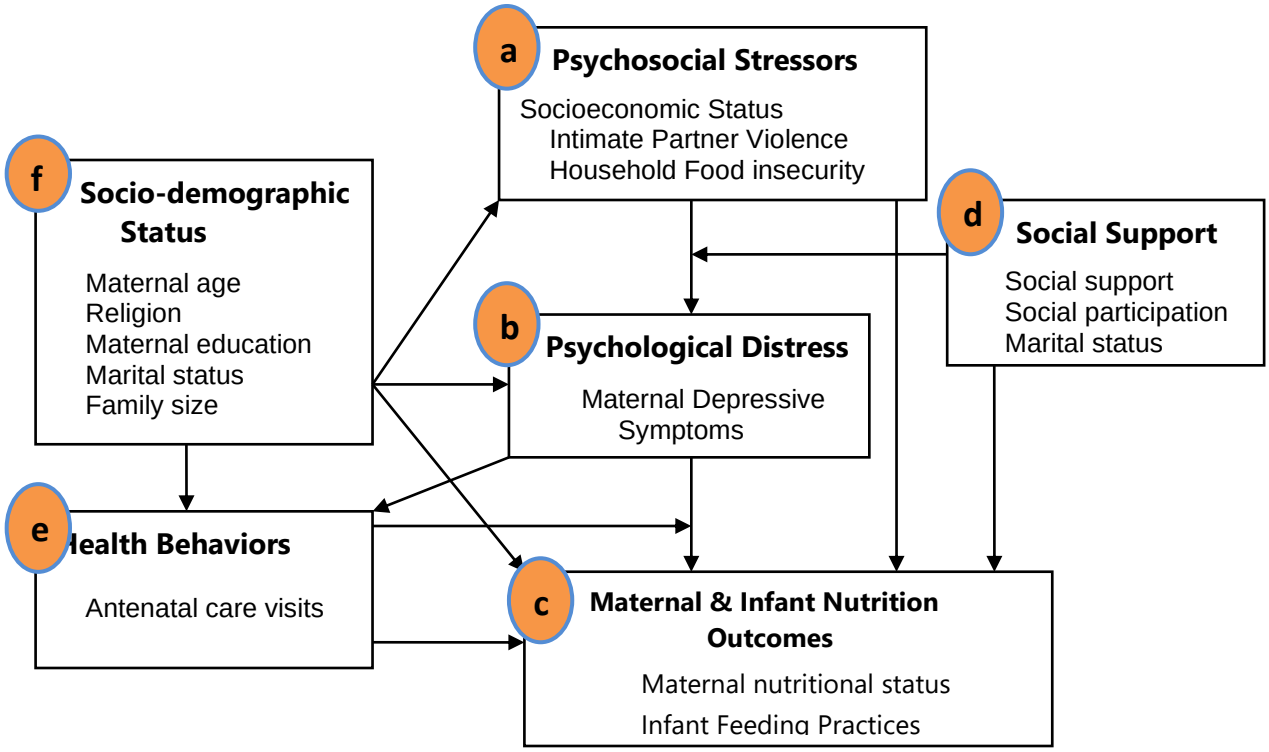

Figure I: Theoretical Model Linking Psychosocial Stressors with Maternal and Infant Nutritional Outcomes

***Legend**: In this model the assumption is that greater exposure to environmental stressors (a) results in greater experience of subjective distress (b). The effect is moderated by coping resources (d). Psychological distress (b) may affect nutritional outcomes (c) directly and indirectly via modifying health behaviors (e). Socio-demographic variables (f) play a confounding effect by associating with the stressors, distresses and even with coping components and the nutrition outcomes.*

1.5. Hypothesis and Objectives of the Study

1.5.1. Hypotheses

Based on the theoretical framework, the following hypotheses were developed and tested in papers II and III.

1. Psychosocial stressors such as intimate partner violence and household food insecurity during pregnancy lead to higher risk of prenatal depressive symptoms.

2. Mothers suffering from prenatal anaemia are at higher risk of having prenatal depressive symptoms than their non-anaemic counterparts

3. Perceived social support from partners, families and friends has a buffering effect and decreases the likelihood of having prenatal depressive symptoms.

4. Infants born from mothers with maternal depressive symptoms (prenatal and postnatal) are more likely to have poor infant feeding practices than their counterparts.

1.5.2. Objectives of the study

There are three general aims for this thesis to achieve: the first aim was to validate depression measurement tool in local language, the second was to contribute empirically based findings to the scientific world examining the role of psychosocial stressors and social supports in prenatal depression. The third was to add knowledge to the field of research investigating the consequences of maternal depression on infant feeding practices.

Paper I: The aim of this study was to validate the 9-item Patient Health Questionnaire (PHQ-9) as a screening tool for depression among Afaan Oromo speaking pregnant Ethiopian women.

Paper II: The main purpose of the second paper was to describe the prevalence of depressive symptoms among pregnant women in Ethiopia and to test two hypotheses derived from the stress theory described in section 1.5.1 above that increased psychosocial stressors leads to depression and strong social support has a protective role. Specifically, the study aimed at determining the association between prenatal depressive symptoms with maternal nutrition, intimate partner violence and social support among pregnant women in rural Ethiopia [**hypotheses I, II & III**].

Paper III: The aim of the third paper was to test the fourth hypothesis that maternal depressive symptoms negatively influence infant feeding practices [**hypotheses III**].

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2

Chapter 2

General Methodology

Chapter 2: General Methodology

2.1. Study Site

2.1.1. Country Profile

Ethiopia is the 27th largest country in the world with a total size of 1,126,829 square kilometers. It is located at 3^0 and 14.8^0 latitude, 33^0 and 48^0 longitude in the Eastern part of Africa. It is bordered by Eritrea to the north, Djibouti and Somalia to the east, Sudan and South Sudan to the west, and Kenya to the south. Ethiopia has a high central plateau that varies from 1,290 to 3,000meters above sea level, with the highest mountain, Ras-Dashen, reaching 4,533m. Ethiopia is the second most populated country in Africa, second to Nigeria, and ranks 12th in the world with an estimated population of 112 million in 2019.

Administratively, the country is divided into ten regional states: Tigray, Afar, Amhara, Benishangul-Gumuz, Gambella, Harari, Oromia, Somali, Sidama and Southern Nations Nationalities and Peoples Region (SNNPR); and two city administrations, namely Addis Ababa and Dire Dawa. Addis Ababa ('New Flower") is the capital city located in the center of the country. The regional states and the city administrations are further divided into 817 districts (Woredas). These districts are further divided into a total of 16,253 Kebeles, the smallest administrative units in the country.

2.1.2. Study Area

Paper I

This study was conducted in Seka-Chekorsa District in Jimma zone, a primarily rural area in Ethiopia situated 370 kilometers southwest of Addis Ababa. This district was selected for the validation study due to its proximity to the main birth cohort study sites, and Afaan Oromo which is the same language as the birth cohort study population is the first language of the majority (88.4%) of the population in this District.

Paper II and III

Paper II and III used data from the Empowering New Generations to Improve Nutrition and Economic Opportunities (ENGINE) birth cohort study. This study was conducted in three districts found in the South west part of Ethiopia in Oromia regional state between 2014 and 2016. The districts were

selected from two administrative zones; namely Jimma Zone (Gomma and TiroAfeta districts) and West Shoa zone (Woliso district).

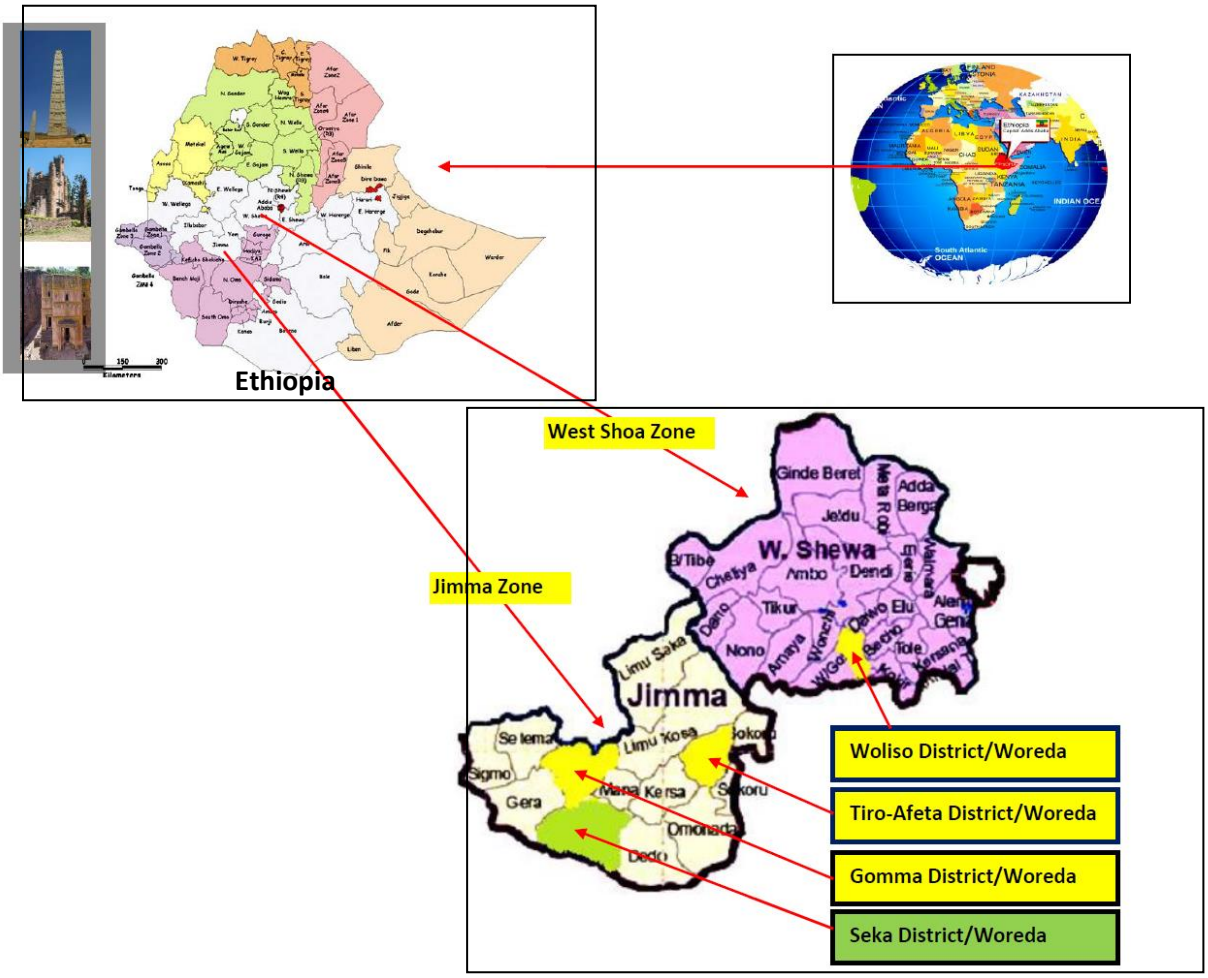

Figure 2.1: Map of the study sites

2.2. Study Design

Paper I: A descriptive cross-sectional study was implemented to investigate the reliability and validity of the Patient Health Questionnaire (PHQ-9).

Papers II and III: This thesis was a sub-study under a large longitudinal, quasi-experimental, birth cohort study which prospectively followed 4680 women from pregnancy through 12 months postpartum. The birth cohort study was conducted as part of the ENGINE program, a five-year integrated nutrition program implemented from 2011-2016 in 100 districts/*Woredas* in Ethiopia and funded by the United States Agency for International Development (USAID). Through an innovative

suite of integrated interventions, ENGINE's primary goal was to help Ethiopian women and children under 5 years to achieve sustainable improvements in their nutritional status, enabling them to lead healthier and more productive lives. The ENGINE birth cohort study was led by Tufts University in partnership with Jimma and Hawassa Universities and Ethiopian Public Health Institute. The study aimed to investigate the benefits of an integrated nutrition program, co-located with an agricultural growth program, on household agricultural production and productivity, food security, diet diversity, socio-economic status and livelihoods, as well as on the health and nutritional status of mothers and their children.

The Principal Investigator (the PhD candidate) for this thesis was also a researcher for the ENGINE research project hired by Tufts University and was involved in and substantially contributed to the birth cohort study design, preparation of the questionnaires, recruitment, training, and supervision of the enumerators, and day to day management of study implementation. For this particular sub-study, the candidate had independently validated the Afaan Oromo language version of the Patient Health Questionnaire (PHQ-9) with a population similar to the birth cohort study targets (see chapter 4 for details) before the start of the main data collection. The validated version of the tool was included as one module of the birth cohort questionnaire.

Photo1: ENGINE birth cohort research team discussing the design

2.3. Study Population

Paper I: A random sample of 246 pregnant women were recruited during their first, second or third trimester. One week later, 29 participants were selected to answer the questionnaire for a second time to evaluate test retest reliability.

Papers II and III: Pregnant women, aged 15-49 years, were recruited from the first trimester of their pregnancy onwards, and were followed from pregnancy to birth. Postpartum, the mother-infant dyads were followed every three months until the infants were 12 months of age.

2.4. Sample size and sampling techniques

Papers II and III: A total of 4,680 pregnant women were recruited from the three Districts. The sample size was calculated to detect a 0.14 (one standard-deviation) change in length-for-age z-score between birth and12 months of age in the infants born to the recruited women, at 80% power at a 0.05 level of significance, allowing for 30% attrition. The high rate of attrition was selected based on prior longitudinal cohort studies which have shown similarly high rates of attrition due to fetal loss, still births, termination of pregnancy, and/or exit of mother from the study due to lack of interest (1).

As the ENGINE interventions were intended to reduce the prevalence of stunting, we usedlength-for-age z-score for sample size estimation. Data collection was conducted at the lowest administrative cluster (kebele) level. Considering an intra-cluster correlation of 0.03, a total of 117 clusters with a total sample size of 40 pregnant women per cluster were included. All kebeles within a district were sampled–with the exception of a few excluded due to inaccessibility–for a total of 1,560 pregnant women recruited in each of the three districts. In each study kebele, study participants were recruited consecutively until the quota of 40 pregnant women was achieved.

2.5. Data Collection

The data were collected at household level by trained data collectors. Health extension workers (HEW) supported the data collectors during the study participant recruitment process. Once informed consent had been obtained, a urine pregnancy test was performed to confirm the pregnancy. Data were collected at seven time points (Table 1). Each participating mother was followed at least once and if possible twice throughout her pregnancy (time points 1 and 2) while the mother-infant pairs were followed for 5 time points (time points 3-7).Women and infants with any health complications during the

data collection period were referred to a nearby health institution. Multiple pregnancies, babies with congenital anomalies, and women with serious medical conditions were excluded from subsequent visits.

Table 2.1: Description of time points

Time point	Description
One	Prenatal one: Early 2nd trimester
Two	Prenatal two: three months after time point one
Three	Immediately after birth
Four	Infant is 3 months old
Five	Infant is 6 months old
Six	Infant is 9 months old
Seven	Infant is 12 months old

2.6. Data quality control

A number of procedures were followed during survey design and implementation to ensure quality of the data. Standard, validated, and pretested instruments were used to collect the data. The questionnaire modules, originally designed in English, were translated into the Afaan Oromo language. In order to minimize errors in data collection and entry, the questionnaires were programmed in the open data kit (ODK) using pre-coded responses and internal checks that required data input before advancing in the questionnaire. The questionnaires in both paper and electronic format were pre-tested in a non-study district prior to training.

Enumerators and field supervisors were recruited based on a set of criteria including prior experience in large-scale survey data collection, fluency in Afaan Oromo, familiarity with electronic data collection tools, and academic background. Data collection and supervision manuals were prepared and a two-week training was conducted on the data collection tool and the measurement techniques included in the study. Prior to data collection, a pilot test was conducted in order to identify variations in questionnaire administration and collection of measurements among the enumerators. Final edits were made on the questionnaire after training and pilot testing.

Meticulous supportive supervision was conducted by field supervisors and the research team. Each evening the field supervisors reviewed the data collected by enumerators prior to submission to the server. Once uploaded to the server, data managers regularly checked quality of the data and returned data errors and incomplete data to the enumerators for correction and justification. Data quality review meetings and refresher trainings were conducted on a regular basis during the data collection period.

Progress, challenges, and remedial actions were documented and reported to the PIs and other research team members by the research manager and data managers on a monthly basis.

2.7. Ethical issues

Ethical clearance was obtained from the Institutional Review Board of Jimma University in Ethiopia (IRB reference number: RPGC/264/2013) and Tufts University in the United States of America (IRB reference number: 11088). Informed written consent was obtained from all individual participants included in the study. All interviews were conducted in private, and confidentiality was ensured for all study participants. The study was also conducted in accordance with the WHO's ethical and safety recommendations for research on domestic violence against women (2). The main principles to justify this research were also fulfilled according to the World Medical Association Declaration of Helsinki (3). During data collection, all measures were taken to ensure that women could access support if it was deemed necessary. Study participants who were screened positive for depressive symptoms or intimate partner violence (IPV) were referred to a nearby health facility for social and medical support.

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3

Chapter 3

Validation of the Patient Health Questionnaire (PHQ-9) as a Screening Tool for Depression in Pregnant Women: Afaan Oromo Version

PLOS ONE

RESEARCH ARTICLE

Validation of the Patient Health Questionnaire (PHQ-9) as a screening tool for depression in pregnant women: Afaan Oromo version

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Abstract

Background

Semantic, technical, content, criterion and conceptual equivalence must be examined in order to validate a psychological rating scale in a new cultural setting. Few validation studies have been conducted in sub-Saharan Africa for scales seeking to detect depression in pregnant women. The aim of this study is to validate the 9-item Patient Health Questionnaire (PHQ-9) as a screening instrument for depression among Afaan Oromo speaking pregnant Ethiopian women.

Methods

A random sample of 246 pregnant women were recruited in Seka Chekorsa District, Ethiopia during their first, second or third trimester. One week later, 29 participants were selected to answer the questionnaire for a second time to evaluate test retest reliability. The Mini International Neuropsychiatric Interview (MINI-Plus) scale was used as a gold standard to evaluate validity. PHQ-9 was compared with MINI-Plus and sensitivity, specificity, accuracy, positive likelihood ratio, negative likelihood ratio and Receiver Operating Characteristic Curves (ROC) for PHQ-9 were calculated. Rasch analysis was also carried out using Winsteps version 3.81.0.

Results

The reliability coefficient, Cronbach's alpha, for the PHQ-9 total score was 0.84. Both the agreement and consistency Intra-class Correlation coefficients (ICC) for the one-week test-retest reliability were 0.98. The cut-off point of a summed score of eight resulted in a sensitivity of 80.8% and a specificity of 79.5%. The calculated area under the curve (AUC) for the PHQ-9 score versus the MINI-Plus was excellent, 0.88 (SE = 0.04; CI = 0.81–0.95). The PHQ-9 meets the criteria established by Linacre for rating scale effectiveness.

Conclusions

The PHQ-9 proved to be a reliable and valid instrument that may be used to screen major depressive disorders among Afaan Oromo speaking Ethiopian pregnant women.

Introduction

A recent literature review on prevalence and determinants of common perinatal mental health disorders by Fisher et al. revealed that only 8% of low and lower-middle-income countries (LMIC) have available data on the antenatal prevalence of common mental disorders, with most of this literature published after 2002 [1]. Furthermore, in nearly all studies, recruitment occurred during antenatal visits at a health facility, which precludes generalizability to women who do not have access to antenatal services. The limited evidence for LMIC, however, indicates that average prevalence is higher than in high-income countries (HIC)[1,2]. Fisher and her colleagues found that the prevalence of antenatal depression among women in LMIC is 15.6%, compared to 10% antenatal prevalence among women in HIC.

One of the reasons for the scarcity of perinatal mental health studies in LMIC may be the lack of validated scales for measuring depressive disorders in these countries. Most of the depressive disorders screening tools available today were developed for populations in HIC [3]. Previous studies showed that study participants in developing countries easily endorse somatic symptoms and are less willing to express emotional distress than people in developed countries [4,5]. In the case of pregnant women, this is further complicated by the similarity between selected symptoms of depression and the common experiences of pregnancy, including changes in sleep patterns, appetite, energy levels and concentration [6]. Furthermore, applying instruments developed in HIC to make conclusions about depression prevalence in LMIC may be inappropriate due to characteristics that are specific to LMIC, such as cultural differences and low literacy rates, which may affect the validity of depression screening tools [7–9].

In order to determine the adequacy of a measurement tool, one must assess the reliability and validity of the instrument. The reliability of the measurement tool can be determined by asking if the tool measures a variable in a consistent way. Validity can be assessed by determining if the instrument is an accurate measure of the underlying construct [10]. Flaherty et al. recommend five major dimensions of cross-cultural equivalence to be examined for validation of a psychiatric rating scale in a new cultural setting [11]. These dimensions include content, semantic, technical, criterion, and conceptual equivalence. After each type of validity is established in the first cultural setting, it must be reassessed in the second cultural setting. Few validation studies for scales assessing major depressive disorder (MDD) have been conducted in sub-Saharan Africa, and none in Afaan Oromo language[12,13]. In this paper, we present validation of the PHQ-9 for antenatal depressive symptoms screening in Oromo pregnant women in a primarily rural area of Ethiopia.

Methods

Setting

The study was conducted in Seka-Chekorsa District; a primarily rural area in Ethiopia situated 370 kilometers southwest of the capital Addis Ababa. In 2012, the District Health office reported a total population of 236,611, of whom 9062 (3.8%) were pregnant women. Afaan Oromo was spoken as a first language by 88.4% of the population in this District.

Design

A descriptive cross-sectional study design was implemented to investigate the reliability and validity of the Patient Health Questionnaire (PHQ-9).

Participants

Two hundred forty six respondents were recruited from six randomly selected *kebeles* (the smallest administrative unit in Ethiopia) in Seka-Chekorsa District. All the respondents agreed to take part in the study. The age of the participants ranged from 18 to 40 years (mean age 24.3 ± 5.6). All of the participants were married with average family size of 4.5 (range 2–11). The median gravidity and parity were 3 (range 1–10) and 2 (range 0–9), respectively. In each kebele, the participants were randomly selected from the Health Extension workers' pregnant women registration book. This list of pregnant women is routinely updated by Health Extension workers in order to plan onsite and outreach services. The Health Extension workers directed selected pregnant women to their interview sites—commonly health posts, Kebele administration offices or school compounds.

The PHQ-9 questionnaire was administered to all 246 participants and 222 (90.2%) participants also volunteered to respond to the MINI-Plus (gold standard). Study participants who did not respond to the MINI-Plus did so simply because they needed to return home to attend routine responsibilities. In order to assess test retest reliability, one week after the first interview, the first 29 participating pregnant women completed the PHQ-9 questionnaire for a second time. The size of the retest sample (n = 29) was sufficient as suggested by Walter et al [14].

Eligibility criteria for participation included age 18 years and above, ability to communicate in Afaan Oromo language, informed consent, and lack of significant cognitive impairment that might interfere with the ability to participate in the interviews. Pregnant women less than 18 years old were excluded in order to avoid confounders due to medical and psychosocial issues unique to adolescent pregnancy.

Instruments

Patient Health Questionnaire (PHQ-9). The PHQ-9 is a 9-item self-administered questionnaire designed to evaluate the presence of depressive symptoms during the prior two weeks. The nine items of the PHQ-9 are based directly on the nine diagnostic criteria for major depressive disorder in the Diagnostic and Statistical Manual Fourth Edition (DSM-IV). The scale has the potential to serve as a dual-purpose instrument that may both screen for the presence of depressive disorder and assess the severity of symptoms [15].

Total PHQ-9 scores range from 0 (absence of depressive symptoms) to 27 (most severe depressive symptoms) to measure severity. Each of the nine items can be scored from 0 (not at all) to 3 (nearly every day). Major depression is diagnosed if five or more of the nine depressive symptoms have been present for at least "more than half the days" (a score of 2) during the past two weeks, and if one of the symptoms is depressed mood or lack of interest (anhedonia).

To date in sub-Saharan Africa, few studies have been published on the psychometric properties of the PHQ-9 [12, 16–18]. Only one study has been conducted in Ethiopia, and was conducted in Amharic language[12]. No PHQ-9 validation studies have been conducted in Afaan Oromo language.

MINI-International Neuropsychiatric Interview PLUS. The MINI-International Neuropsychiatric Interview (MINI-Plus) is a short structured diagnostic interview, developed jointly by psychiatrists and other clinicians, for diagnosis of the most common DSM-IV and ICD-10 psychiatric disorders [19].

For the purposes of this study, the English version of the MINI-Plus was translated into Afaan Oromo language by two native speaker mental health specialists. This version was later revised after involvement by a third specialist. The MINI-Plus includes 23 disorders, but for the current study only the modules for depressive disorders were used. The instrument was administered by two mental health specialists who were trained by a specialist with prior experience in applying the MINI-Plus instrument. Prior to the main study, the two raters interviewed 20 individuals using the MINI-Plus scale and agreed on the depression status of 18 respondents (90%). The inter-rater reliability showed substantial agreement (Kappa = 0.80, 95% CI: 0.519, 1.00, P<0.001).

Semantic validation

Afaan Oromo is spoken by about 34% of the population in Ethiopia. Within Ethiopia, Oromo is the language with the largest number of native speakers [20]. The main dialects of Afaan Oromo in Ethiopia are Wellega (spoken in the West Wellega, East Wellega, Illubabor, and Jima zones), Tulama (in the North, West, and East Shoa zones), Wello (in Northern Shoa and Southern Amhara), Arsi (in the Arsi and Bale zones), Harar (in the West and East Harerge Zones), and Borena (in the southern-most zone by the same name). This validation study was conducted for Wellega and Tulama dialects.

Translation

Translation and cultural adaptation of the PHQ-9 was performed according to 'The Minimal Translation Criteria' [21]. Two independent bilingual translators (psychologist and health education specialist) with advanced levels of English language and native Afaan Oromo language skills translated the questionnaire into Afaan Oromo (forward translation). With the contribution of a third reviewer with expertise in mental health, a reconciliation meeting was conducted to develop a consensus version (reconciliation Afaan Oromo version). An English language lecturer, who is a native Afaan Oromo speaker and who had been blinded to the original version, retranslated the reconciliated Afaan Oromo version into the source language (back translation). There were no major difficulties in reconciling the back-translated version.

Cognitive debriefing

A cognitive debriefing process was applied for the cultural adaptation of the questionnaire as the last step of the translation procedure [21]. This process was carried out in order to identify any areas presenting linguistic problems and to assess the participants' level of understanding in order to reveal inappropriate items and translation alternatives. As part of this process, the questionnaire was administered to 21 Afaan Oromo speaker pregnant women who were at different gestational ages. In the interview, all items were revised for comprehension (meaning and question objectives), information retrieval (type of information and recall strategy), decision process (sensitivity and social desirability), and adequacy of response options. Feedback was discussed in a debriefing summary before the final Afaan Oromo version of PHQ-9 was adapted.

The Afaan Oromo version of the PHQ-9 instrument was administered to 246 pregnant women by clinical nurses working in the psychiatry department of Jimma University specialized Hospital. Participants were then interviewed using the Afaan Oromo version of the MINI-Plus questionnaire by two mental health specialists who were blind to PHQ-9 results. In order to minimize order effects, respondents were randomized to receive the PHQ-9 or the MINI-Plus interview first.

Statistical analysis

The data were analyzed using SPSS for Windows version 20 (Chicago, Illinois), Winsteps ver. 3.80.1 and STATA version 12. Descriptive characteristics were calculated for the socio-demographic variables. Reliability related to internal consistency was measured by Cronbach's alpha coefficient (Cronbach's α), while test-retest reliability was assessed by intra-class correlation coefficients (ICCs).

The sensitivity, specificity, accuracy, positive likelihood ratio and negative likelihood ratio were calculated for different cut-off scores of the PHQ-9 to construct a Receiver Operating Characteristic (ROC) curve. The area under the curve (AUC) was used to address the performance of a test. An AUC of 1.0 indicates perfect accuracy, while an AUC of 0.5 indicates a non-discriminating test. Youden Index, calculated as sensitivity plus specificity minus one and converted to a percent, was computed as an additional metric for cutoff determination. Although there are no empirical cutoffs for Youden Index, values above 50% are generally considered suitable values of diagnostic accuracy [22].

An exploratory factor analysis (EFA) was performed in order to determine the structure of the questionnaire [23,24]. The number of factors was determined with reference to the Kaiser criterion of Eigenvalues and the scree test [25]. A factor was considered important if its eigenvalues exceeded 1.0 [26].

Finally, Rasch analysis was conducted to substantiate the evidence suggesting the PHQ-9 scale is a reliable and valid tool for screening antenatal depression. The analysis was carried out according to the Andrich Rating Scale model [27] using Winsteps version 3.81.0 [28] to evaluate the operation of the response categories, to see how reliably respondents discriminated between response categories and to identify how well each item contributed to the underlying measure [29]. In Rasch analysis, the probability of an individual's choosing a response on a particular item depends on both the person ability and item difficulty. For measurements assessing depression, "item difficulty" refers to the level of depression expressed by the item and "person ability" refers to the extent to which the study participants possess the depression [30,31].

Ethical considerations

Ethical approval was obtained from the research ethical review board of Jimma University. Informed consent was obtained from each study participant and all interviews were conducted in private. Study participants who were screened as depressed or with suicidal attempts using the MINI-Plus were referred for psychiatric care.

Results

The median PHQ-9 score was 4 (range 0–26) and items representing alterations in energy, sleep and appetite were the most commonly reported items, respectively. A total of 44 participants fulfilled DSM-IV criteria for MDD on the PHQ-9 (17.8%; 95% CI 13.0–22.6%). When interviewed by psychiatrists using the MINI-Plus questionnaire, a total of 28 participants (12.6%) fulfilled the DSM-IV criteria for MDD. PHQ-9 scores were higher among depressed individuals (mean = 13.5) compared to the non-depressed individuals (mean = 4.3).

Reliability

Cronbach's alpha for the PHQ-9 total score was 0.84. The correlations between nine items of the PHQ-9 and the total scores ranged from 0.30 to 0.54, and all correlations were statistically significant (all 2-tailed p-values <0.01). One-week test-retest reliability of PHQ-9 total score

was 0.98 for both agreement and consistency ICC indices. The mean PHQ-9 total score did not significantly increase over the two occasions (7.9 to 8.6, two-sided paired t test, p = 0.08). The quadratic and linear weighted kappa were 0.97 and 0.86 respectively for PHQ-9 severity categories ($p < .0001$).

Validity

Semantic validity. This study's translation of the PHQ-9 into Afaan Oromo favored the Wellega and Tulama Afaan Oromo dialects. Key words from the nine items of the questionnaire were first translated into Afaan Oromo words of many different dialects by the two translators. From these options, words commonly known in Wellega and Tuloma dialects were chosen during the consensus meeting. There were no major difficulties in reconciling the back-translated version.

Technical validity. To simplify administration of the PHQ-9 as an interview rather than a self-administered questionnaire, each statement was converted into question form. Besides, to provide reminders of the time interval for the recall, each item was introduced with a prefix 'In the last two weeks. . .'. While participants understood the item scale and the two weeks recall period, they found it confusing to differentiate the response categories (e.g., "more than half the days" in reference to two weeks). To overcome this difficulty, a bar graph depicting the severity levels across response options was used in addition to reading the options. Respondents found the graph easier to understand than the verbal options.

Content validity. The cognitive debriefing revealed that the PHQ-9 was generally well understood, acceptable and culturally appropriate for all the respondents. However, interpreting opposite symptoms in items representing alterations in sleep, appetite and psychomotor agitation/retardation was challenging for the majority of participants who repeatedly asked how it would be possible to respond to two opposing events simultaneously. Upon hearing an explanation, participants understood that the items referred to changes in behaviors in either direction. To overcome this difficulty, these items were asked twice, each direction separately, and questionnaire administrators recorded the more severe response of the two.

Criterion validity. Table 1shows sensitivity, specificity, accuracy, positive likelihood ratio, negative likelihood ratio and Youden's index for each of the PHQ-9 cut scores compared to the gold standard interview. As expected, sensitivity decreased progressively as the cut scores increased, with a marked decrease between the ≥8 and ≥9 cut scores (from 80.8% to 69.2%). In contrast, specificity between these two cut scores increased from 79.4% to 84.7%. Both

Table 1. Detailed report of sensitivity and specificity of PHQ-9 among Afaan Oromo speaking Ethiopian pregnant women, 2017.

Cut point	Sensitivity	Specificity	Classified	LR+	LR-	Youden's Index
(> = 5)	92.31%	57.37%	61.57%	2.1652	0.1341	49.68%
(> = 6)	88.46%	66.32%	68.98%	2.6262	0.1740	54.78%
(> = 7)	80.77%	74.74%	75.46%	3.1971	0.2573	55.51%
(> = 8)	**80.77%**	**79.47%**	**79.63%**	**3.9349**	**0.2420**	**60.24%**
(> = 9)	69.23%	84.74%	82.87%	4.5358	0.3631	53.97%
(> = 10)	65.38%	86.32%	83.80%	4.7781	0.4010	51.70%
(> = 11)	65.38%	89.47%	86.57%	6.2115	0.3869	54.85%
(> = 12)	61.54%	94.74%	90.74%	11.6923	0.4060	56.28%
(> = 13)	50.00%	94.74%	89.35%	9.5000	0.5278	44.74%
(> = 14)	46.15%	97.37%	91.20%	17.5384	0.5530	43.52%

LR+ = Likelihood Ratio Positive **LR-** = Likelihood Ratio Negative

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Youden's index and the cut scores of maximum sensitivity and specificity according to the ROC curve (Table 1) indicated the ≥8 cut scores as the most suitable for identifying pregnant women at increased risk of having depression. A total of 60 women (27.8%; 22.2–33.8%) scored ≥ 8 in the PHQ-9. Sensitivity at this cut score was 80.8% with specificity of 79.5%. The positive likelihood ratio at this point was 3.9 and negative likelihood ratio of 0.24.

The ROC curve, calculated for PHQ-9 is shown in Fig 1. The calculated AUC for the PHQ-9 score versus the MINI-Plus was 0.878 (SE = 0.036; CI = 0.807–0.949).

Construct validity (factor analysis). The *Kaiser-Meyer-Olkin* (KMO) measure of the quality of the correlation matrix was high (KMO = 0.838). A significant Bartlett test of sphericity justified a dimension reducing procedure such as the factor analysis. The measure of sampling adequacy was greater than 0.80, so the items could be considered suitable for factor analyses. The scree plot revealed one dominant dimension with a big decrease between first and second eigenvalues and small decreases afterward (eigenvalues: 3.97, 1.02, 0.92, 0.71, 0.61, 0.53, 0.49, 0.45 and 0.30). Factor loadings ranged from 0.61 to 0.73 i.e., above 0.45 cutoff [32]. The percentage of total variance explained by the first factor was 44.1%.

Rasch scale analysis

Rating scale utilization. The PHQ-9 meets the criteria established by Linacre [33] for rating scale effectiveness (Table 2). All category frequency counts are large (range from 189 to 1445) and the frequency difference is unimodal. All the average measures increase monotonically with rating scale category from -1.81 to -0.71 logits (a jump of 1.1 logits), from -0.71 to -0.23 logits (a jump of 0.51 logits), and then from -0.23 to 0.49 (a jump of 0.72 logits). Similarly, all categories have an acceptable mean-square (range from 0.78–1.12) indicating that the scale has a reasonably uniform level of randomness throughout the data. Furthermore, the step calibration -0.77, -0.04 and 0.80 are ordered and both the inference of measures-to-ratings and

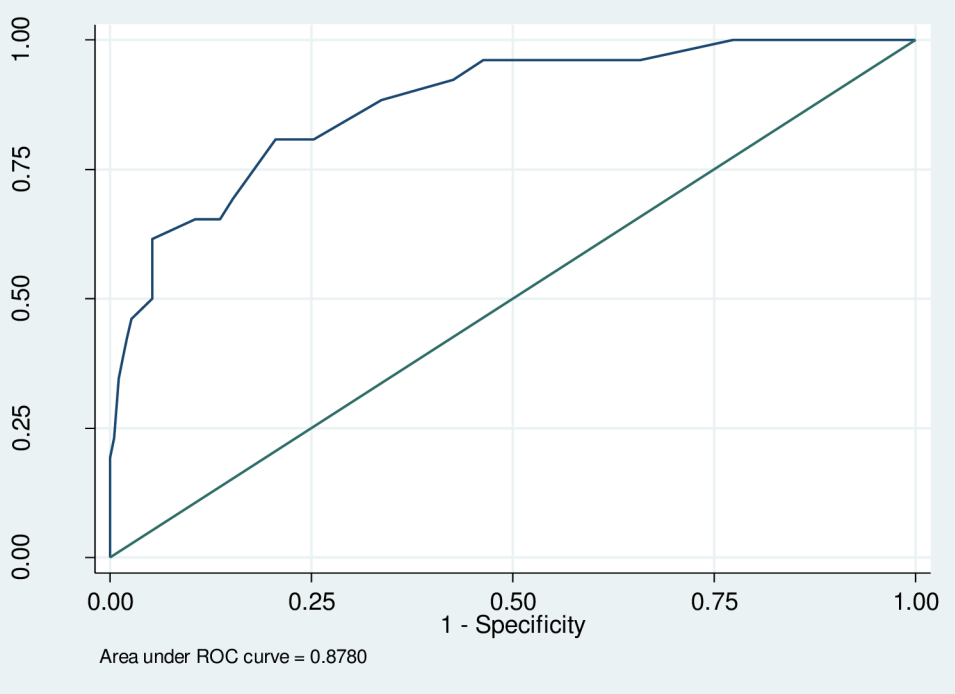

Fig 1. Receiver Operating Characteristic curves for PHQ-9 (n = 216).

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Table 2. Rasch analysis of the PHQ-9 scale.

Category label	Category		Average measure	Expected measure	Outfit calibration	Step calibration	Coherence M—> C	Coherence M—> C	Zone	
	Count	%							From	To
O	1445	65	-1.81	-1.76	0.96	-	84%	75%	-∞	-1.15
1	349	16	-0.71	-0.92	0.78	-0.77	31%	52%	-1.15	-0.02
2	231	10	-0.23	-0.20	1.12	-0.04	32%	34%	-0.02	1.15
3	189	9	0.49	0.60	1.11	0.80	71%	22%	1.15	+∞

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ratings to measures are generally strong and successful. Finally, step difficulties advanced by at least 1.4 logits (from -1.15 to +1.15 logits, a distance of 2.3 which is sufficiently large) and by less than 5.0 logits.

Unidimentionality. Unidimentionality was assessed through analysis of Infit mean square (MNSQ) residuals, standardized Z (Zstd) values and point measure correlation and through principal component analysis.

Fit Statistics: Analysis of individual item fit revealed that all of the items were within the acceptable values for Infit MNSQ (0.93 to 1.28) and Zstd (less than 2.0). Moreover, the point measure correlation for the items (range from 0.44 to 0.72) indicated that the items were highly correlated with one another (Table 3).

Principal Component Analysis: To judge the strength of the measurement dimension, the following cut off points were used for variance explained by the measure: >40% is considered a strong measurement dimension, >30% is considered a moderate measurement dimension, and >20% is considered a minimal dimension [34]. A ratio of 3 to 1 of variance explained by the measure to variance in the first contrast was also considered. As indicated in Table 4, variance explained by the measure is 47.2% which is strong principal measurement dimension. Secondly, 17.0% of the variance is explained by the first factor of residuals. The ratio of 47.2 to 17.0 is about 3 to 1 which is supportive of unidimentionality.

Item hierarchy. Fig 2 represents the items in order of difficulty calibrated against person ability on a single interval scale, where the intervals are measured on the logit scale. The "Xs" on the left of the vertical axis corresponded to the person ability measures. As anticipated, there was an uneven spread of items across the full range of the participant's scores, which indicates that most participants had low levels of depressive symptoms. The item hierarchy reveals that the item about suicide ideation was the most difficult to report whereas the items about trouble falling sleep and feeling tired were easier to report. The top factor (depressed mood, feeling of worthlessness, trouble concentrating and suicidal thoughts) is related to

Table 3. Item fit statistics of the PHQ-9 questionnaire using the Rasch analysis.

Entry number	Total score	Count	Measure	Model S.E.	Infit		Outfit		PTMEA corr.	Items
					MNSQ	Zstd	MNSQ	Zstd		
9	41	246	1.39	0.16	1.28	1.30	0.84	-0.40	A 0.44	PHQ9
4	294	246	-1.12	0.08	1.00	0	1.18	1.50	B 0.71	PHQ4
8	115	246	0.25	0.10	1.15	1.20	1.04	0.30	C 0.57	PHQ8
5	172	246	-0.26	0.09	1.07	0.70	1.12	0.80	D 0.62	PHQ5
1	151	246	-0.09	0.09	1.06	0.60	1.11	0.70	E 0.59	PHQ1
7	112	246	0.28	0.10	1.06	0.50	0.94	-0.30	d 0.58	PHQ7
6	105	246	0.35	0.11	1.05	0.40	0.76	-1.30	c 0.58	PHQ6
2	134	246	0.06	0.10	1.04	0.40	0.95	-0.30	b 0.60	PHQ2
3	254	246	-0.85	0.08	0.93	-0.70	0.90	-0.80	a 0.72	PHQ3

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Table 4. Principal component analysis of standardized residual correlations for items (in eigenvalue units).

	Observed		Expected	
Total raw variance in observations	17.1	100.0%		100.0%
Raw variance explained by measures	8.1	47.2%		49.5%
Raw variance explained by persons	2.8	16.5%		17.3%
Raw Variance explained by items	5.2	30.7%		32.2%
Raw unexplained variance (total)	9.0	52.8%	100.0%	50.5%
Unexplained variance in 1st contrast	1.5	9.0%		17.0%
Unexplained variance in 2nd contrast	1.5	8.5%		16.2%
Unexplained variance in 3rd contrast	1.3	7.6%		14.4%
Unexplained variance in 4th contrast	1.2	6.8%		12.8%
Unexplained variance in 5th contrast	1.0	6.0%		11.5%

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cognitive/affective symptoms. The bottom (trouble falling sleep, feeling tired or having little energy and appetite disturbance) concerns somatic symptoms [35]; these symptoms are common among pregnant women even when they are not depressed [6]. Thus, in general, somatic components of the items in the scale were easier to report than the affective components. However, item 8 (psychomotor agitation or retardation) which is a somatic symptom was difficult to report and item 1 (lack of interest) which is an affective symptom was comparably easier to report.

Floor/ceiling effects and item redundancy. In Fig 2, the Xs at the bottom left represent the 45 individuals (18.5% of sample) who rated all items 0 "not at all". This exceeds the 15% cutoff point to state the presence of a floor effect [36]. It is likely that extreme items are missing in the lower end of the scale, indicating limited content validity. There was no ceiling effect (individuals who rated all item 3 "nearly every day"). No two or more items were situated at the same logit; thus, no redundant items were found in this study.

Internal consistency. Internal consistency was determined by examining separation index and reliability for persons and items (Table 5). In this study, the person separation index for the PHQ-9 is 1.54, indicating that the questionnaire categorized individuals into two distinct strata or levels of ability (depressed and non-depressed). Person reliability index, analogous to Cronbach's alpha, was 0.70. The item separation index for the PHQ-9 is 6.54, which allows for categorization into 9 distinct strata. Item reliability index was 0.98. The high item reliability indicates that the relative order of item difficulty and the high reproducibility of the test items were consistent along the estimated continuum. Thus, the PHQ-9 demonstrates good internal consistency.

Discussion

To the authors' best knowledge, this is the first validation of an Afaan Oromo version of the PHQ-9 questionnaire as a screening tool for depressive symptoms among pregnant women in Ethiopia. The main finding of this study is that the PHQ-9 scale has acceptable reliability and validity as a screening instrument for depressive symptoms among Afaan Oromo speaking Ethiopian pregnant women.

The strong internal consistency (Cronbach's alpha = 0.84) suggests that the instrument is a highly reliable tool for screening depression in this study population. The acceptability of the internal consistency was further confirmed by the higher person and item separation reliability indices on the Rasch analysis. The test-retest reliability is higher than that of previous studies in sub-Saharan Africa [12, 17–19].

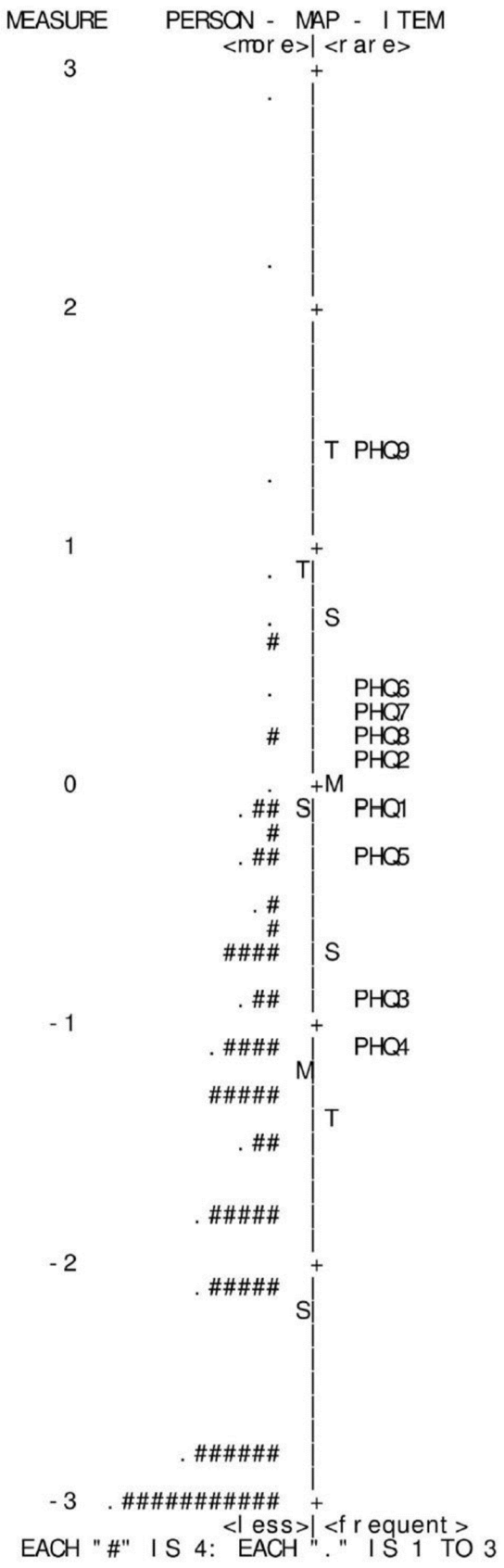
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Fig 2. Person-item location map of the Rasch-scaled PHQ-9 showing the distribution of calibrated respondents' scores (left hand side) and item locations (right-hand side).

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The cognitive debriefing revealed that the PHQ-9 was generally well understood, acceptable and culturally appropriate for all the respondents. However, interpretation of opposite symptoms in items 3 (trouble falling sleep), 5 (appetite disturbance) and 8 (psychomotor agitation or retardation) was challenging for the majority of participants. Williams et al. cited this obstacle as a potential limitation for the PHQ-9 in their 2009 study, noting that items containing polar opposite symptom descriptions may be difficult for some subjects to understand and could affect the psychometric properties of the PHQ-9 [37]. We suggest splitting these items to convert the PHQ-9 into PHQ-12 or asking these items forward, then backward, and scoring the more severe response as a symptom.

The mean scores on the PHQ-9 in the MINI-Plus depressed group versus the MINI-Plus non-depressed group were significantly different. This supports the construct validity of the PHQ-9. This screening tool also showed good criterion validity; the optimal cut-off value was eight. At this value, the PHQ-9 has a sensitivity of 80.8% and specificity of 79.5%. These values of sensitivity and specificity for the Afaan Oromo PHQ-9 are acceptable [38]. That means, 80.8% of pregnant women with depressive symptoms (according to the MINI-Plus), will be detected by the PHQ-9 and 79.5% of pregnant women without depressive symptoms by MINI-Plus will score negative on the PHQ-9. This finding is consistent with a meta-analysis [39] which reported that the PHQ-9 has acceptable diagnostic properties for detecting MDD for cut-off scores between eight and eleven. The pooled analysis revealed that specificity estimates summarized across 11 published studies ranged from 73% to 96% for PHQ-9 cut-off scores between 7 and 15.

An Amharic, hospital-based PHQ-9 validation study in Ethiopia showed that a threshold of ten was the most appropriate cutoff and offered the optimal discriminatory power in detecting MDD [12]. The relatively higher cutoff value reported in this study may be due to the medical patients over-reporting their somatic symptoms e.g. fatigue and anorexia, which could have resulted from their physical illnesses.

Despite few studies noting that PHQ-9 items may not accurately capture all components of MDD[30,37,40], the results of the Rasch analysis for this study did not detect item misfit using the mean infit and outfit square criteria set a priori. This is consistent with the Amharic PHQ-9 validation study in Ethiopia [12]. However, among the PHQ-9 items, item 3 (trouble falling sleep) and item 4 (feeling tired or having little energy) were easier to report while the question

Table 5. Summary of 201 measured (non-extreme) person and 9 measured (non-extreme) item.

	Total score		Count		Measure		Model error		Infit				Outfit			
									MNSQ		Zsth		MNSQ		Zsth	
	P	I	P	I	P	I	P	I	P	I	P	I	P	I	P	I
MEAN	6.9	153.1	9	9	-1.15	-1.15	0.53	0.53	1	1	0.1	0.1	0.98	0.98	0.1	0.1
S.D.	5.3	73.6	0	0	1.03	1.03	0.2	0.2	0.54	0.54	1	1	0.8	0.8	0.9	0.9
MAX.	26	294	9	9	2.86	2.86	0.99	0.99	3	3	3.7	3.7	5.27	5.27	3.7	3.7
MIN.	1	41	9	9	-2.76	-2.76	0.35	0.35	0.15	0.15	-2.9	-2.9	0.18	0.18	-2.2	-2.2
REAL RMSE	0.6	0.11	TRUE SD		0.83	0.68	SEPARATION		1.38	6.19	PERSON RELIABILITY				0.66	0.97
MODEL RMSE			TRUE SD		0.86	0.68	SEPARATION		1.54	6.54	PERSON RELIABILTIY				0.7	0.98

S.E. OF PERSON MEAN = 0.07 (Person) S.E. OF PERSON MEAN = 0.24 (Item)

ITEM RAW SCORE-TO-MEASURE CORRELATION = -.97 P = Person I = Item

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about suicidal thoughts (item 9) was the most difficult to report. This may be due to cultural values and reasons that impact reporting of certain depressive symptoms in this society [41]. Furthermore, suicidal thoughts indicate a more severe form of depression which is less common in community samples.

Both the factor analysis and the Rasch analysis revealed that a single factor model exists among the nine items of the PHQ-9 for Ethiopian pregnant women. This finding is consistent with previous studies that showed a single factor structure of the PHQ-9[12–14,30,39–44]. Thus, the PHQ-9 measures a single construct i.e. depressive disorder.

One of the limitations of the study is that participants may not represent all of the Afaan Oromo speaking population in Ethiopia because Afaan Oromo language has different dialects and the translation and cognitive debriefing were based on the Wellega and Tulama dialects. Additionally, as all of the assessments were conducted through interviews, technical validity-or comparison with self-administered formats-of the PHQ-9 was not assessed due to high illiteracy. Nevertheless, our findings support the utility of Afaan Oromo version of the PHQ-9 as screening tool for depressive symptoms during pregnancy in rural Ethiopia. The screening could potentially be integrated into routine home visits by rural Health Extension Workers.

In conclusion, the PHQ-9 has acceptable reliability and validity for screening of antenatal depressive symptoms and for measuring the severity of depressive symptoms for Afaan Oromo speaking rural Ethiopian pregnant women.

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Chapter 4

The role of Nutrition, Intimate Partner Violence and Social Support in Prenatal Depressive Symptoms in Rural Ethiopia: Community Based Birth Cohort Study

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The role of nutrition, intimate partner violence and social support in prenatal depressive symptoms in rural Ethiopia: community based birth cohort study

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Abstract

Background: Depression during pregnancy has far-reaching adverse consequences on mothers, children and the whole family. The magnitude and determinants of prenatal depressive symptoms in low-resource countries are not well established. This study aims to describe the prevalence of prenatal depressive symptoms and whether it is associated with maternal nutrition, intimate partner violence and social support among pregnant women in rural Ethiopia.

Methods: This study is based on the baseline data from a large prospective, community-based, birth cohort study conducted in the South Western part of Ethiopia from March 2014 to March 2016. A total of 4680 pregnant women were recruited between 12 and 32 weeks of gestation. Depressed mood was assessed using the Patient Health Questionnaire (PHQ-9) scale and a cut off of ≥8 was taken to define prenatal depressive symptoms. Data collection was conducted electronically on handheld tablets and submitted to a secured server via an internet connection. Bivariate and multivariate logistic regression analyses were computed using IBM SPSS version 20 software.

Result: The community based prevalence of depressive symptoms during pregnancy was 10.8% (95%Confidence Interval (CI): 9.92–11.70). Adjusting for confounding variables, moderate household food insecurity (OR 1.74; 95% CI: 1.31–2.32), severe household food insecurity (OR 7.90; 95% CI: 5.87–10.62), anaemia (OR = 1.30; 95% CI: 1.04–1.61) and intimate partner violence (OR 3.08; 95% CI: 2.23–4.25) were significantly associated with prenatal depressive symptoms. On the other hand, good social support from friends, families and husband reduced the risk of prenatal depressive symptoms by 39% (OR 0.61; 95% CI: 0.50–0.76).

Conclusion: Prenatal depressive symptomatology is rather common during pregnancy in rural Ethiopia. In this community based study, household food insecurity, anaemia and intimate partner violence were significantly associated with prenatal depressive symptoms. Good maternal social support from friends, families and spouse was rather protective. The study highlights the need for targeted screening for depression and intimate partner violence during pregnancy. Policies aimed at reducing household food insecurity, maternal anaemia and intimate partner violence during pregnancy may possibly reduce depression.

Keywords: Prenatal depression, Household food insecurity, Anaemia, Intimate partner violence, Social support, PHQ-9, Ethiopia

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Background

Major depression is the leading cause of the global burden of disease today [1]. It is also the most prevalent psychiatric disorder during pregnancy [2]. Prenatal depression can lead to serious health risks for both the mother and infant [3, 4]. A recent systematic review revealed that in low- and lower-middle-income countries (LMICs) average prevalence of perinatal mental disorder (25.3%: 95% CI: 21.4–29.6%) was considerably higher than the 7–15% prevalence in high-income countries [2]. Nonetheless, low-income countries assign about 0.5% of their health budget to mental health while high-income countries devote 5.1%, an amount, still disproportionately small (given the prevalence and impact of mental disorders), to implement a series of highly cost-effective interventions [1].

In Ethiopia the prevalence of prenatal depression varies widely based on the instruments used and study settings. A 12% prevalence of prenatal depression was reported using PHQ-9 scale [4], 23% using Beck Depression Inventory (BDI) scale [5], 25% using Edinburgh Postnatal Depression Scale [6] and 31.5% using WHO Self-Reported Questionnaire with 20 items (SRQ-20) [7]. A community based study showed a 12% prevalence of common mental disorder during pregnancy [4]. Whereas, health facility based studies revealed 23–31.5% prevalence [5–7].

Based on previous research findings in low, middle and high income countries, socio-demographic factors such as age [5, 8], income [9] and educational attainment [7] were identified as factors affecting prenatal depressive symptoms. Clinical factors includes previous depression [8], concomitant high anxiety in pregnancy (Strewart et al., 2003) and a history of miscarriage and induced abortion [10, 11]. Studies also showed that household food insecurity [12] and anaemia [13] are identified as nutrition related factors for prenatal depression. A number of studies also indicated that intimate partner violence is another factor associated with depression during pregnancy [14, 15].

Several studies have shown a role of nutrition in mental distress, and they mostly documented the psychological effects of nutrient deficiencies. These studies indicated that deficiencies in folate, vitamin B12, calcium, iron, selenium, zinc, and polyunsaturated fatty acids (PUFAs) are associated with depression. Particularly, omega-3 fatty acids are getting special attention regarding their efficacy in depression treatment [16]. Nutrition is a modifiable risk factor, and therefore is possible to be improved with targeted programs in addition to support programs to reduce maternal distress [17].

Studies exploring the association between maternal nutrition and prenatal depression are still inconclusive and the limited studies available did not control for important variables such as intimate partner violence and social support [18]. In Ethiopia, though the prevalence and determinants of intimate partner violence is well studied in the general population, there are limited data describing its association with prenatal depression [19]. This study aims to describe the prevalence of prenatal depression and whether it is associated with maternal nutrition, intimate partner violence and social support among pregnant women in rural Ethiopia.

Methods

This study utilizes baseline data from a prospective, community-based, quasi-experimental birth cohort study within Empowering New Generations to Improve Nutrition and Economic opportunities (ENGINE) program. ENGINE is a USAID funded program, which aims to improve nutritional status of mothers' and young children in Ethiopia through a multi-sectoral approach targeting health, nutrition and agriculture. The ENGINE birth cohort study was led by Tufts University and aimed to investigate the benefits of an integrated nutrition program and its co-location with agricultural growth program on household agricultural production and productivity, food security, diet diversity, socio-economic status and livelihoods, as well as health status, anthropometry and hemoglobin for mother and her child.

This study had an open cohort design, with rolling recruitment and follow up of pregnant women for a period of two years. The study was conducted from March 2014 to March 2016 in three Districts (Woliso, Tiro-Afeta and Gomma) in the South Western part of Ethiopia. A total of 4680 pregnant women were recruited between 12 to 32 weeks of gestation and followed up until 12 months postpartum. Data was collected once during pregnancy for all women (twice for those in the first trimester at recruitment), at birth, and then every three months until the child was 12 months old. Data collection was conducted by trained nurses electronically using Open Data Kit (ODK) software on handheld tablets and submitted to a secured server via an internet connection. Ethical clearance was obtained from Jimma University ethical review board. Informed written consent was obtained from all individual participants included in the study. All interviews were conducted in private and confidentiality was ensured for each study participants.

Measurements

Depressive symptoms

Prenatal depressive symptoms were assessed using the patient health questionnaire (PHQ-9). The PHQ-9 is a 9-item self-administered questionnaire designed to evaluate the presence of depressive symptoms during the prior two weeks [20]. Each of the nine items can be scored from 0 (not at all) to 3 (nearly every day). Thus, total score can range from 0 (absence of depressive symptoms) to 27 (most severe depressive symptoms). This instrument had

been validated for Afaan Oromo Language in a similar population prior to the commencement of the ENGINE birth cohort study and possessed good psychometric properties. A PHQ-9 score of 8 or above was taken as a cut off to define prenatal symptomatology [21].

Nutritional status

Mid upper arm circumference (MUAC) was used to estimate maternal nutritional status. It was measured three times at each visit at the midpoint between the tip of the shoulder and the elbow of the left upper arm using inelastic adult MUAC tape. The average of three MUAC measurements was calculated and then categorized as normal or low MUAC. A MUAC of less than 23 cm was considered to be a sign of poor nutrition [22].

Anaemia

Haemoglobin concentration was measured using HemoCue® Hb 301 system for mobile screening. One drop of blood was collected in a HemoCue microcuvette and the haemoglobin concentration was read directly in the field. Anaemia was defined as haemoglobin concentration < 11 g/dl after adjusted for altitude and pregnancy to get the sea level value according to the method described by Cohen and Hass [23].

Household food insecurity

The household food insecurity was measured using the Household Food Insecurity Access Scale [24]. The index women were asked nine questions (yes/no) to determine if anyone in their household had experienced problems of food access over four weeks preceding the interview. An affirmative response to any of the nine questions was followed by a question to determine how often the condition happened: rarely (1–2 times), sometimes (3–10 times), and often (> 10 times). Responses were coded as 0 = never (i.e., no experience), 1 = rarely, 2 = sometimes, or 3 = often. Household food insecurity was categorized into four severity levels: food secure, mildly food insecure, moderately food insecure, and severely food insecure as per the algorithm described by Coates et al. [24].

Socio-demographic factors

Educational status of the index mother was dichotomized as above primary school and primary or below for analysis purpose. Marital status was dichotomized into married (married monogamous and married polygamous) and unmarried (single, widowed, divorced, and separated). Religion was categorized into three as Protestant and Catholic, Muslim and Orthodox (only 3 respondents were follower of traditional religion or pagan and hence were not separately analyzed).

Obstetric related risk factors

Gravidity, gestational age, acute illnesses in the past two weeks, place of previous delivery and history of previous antenatal care visits; previous child death and spontaneous abortion were considered obstetric-related risk factors. Gravidity was categorized into primi-gravida (first pregnancy), multi-gravida (2–4 pregnancy experience) and grand-multi-gravida (five or more than five pregnancy experiences). While gestational age was categorized into three as first trimester (up to 12 weeks of gestation), second trimester (13–26 weeks of gestation) and third trimester (above 26 weeks of gestation).

Intimate partner violence (IPV)

A screening tool called HITS (Hurt, Insult, Threaten and Scream) was applied to assess intimate partner violence. This screening tool measures the emotional (psychological) aspects of intimate partner violence. The scale has four items and each item was scored on a scale of 1 (never) to 5 (frequently) and later the sum score was computed. A total score of > 10 is suggestive of IPV [25].

Maternal social support

Maternal Social support was measured using the Maternity Social Support Scale (MSSS) developed by Webster and colleagues [26]. The scale contains six items. Each item has measured on a five-point Likert scale and a total score of 30 was possible. We classified social support into two categories based on the mean score; below mean and mean or above mean score.

Data analysis

The data was analyzed using SPSS version 20. Bivariate and multivariate logistic regression analyses were computed to examine the relationship between the independent variables and prenatal depressive symptoms. The binary form of the dependent variable was coded as "1" for prenatal depressive symptoms (PHQ-9 score > = 8) and "0" for the absence (PHQ-9 score < 8). First binary logistic regression analyses were conducted between each individual independent variable and prenatal depressive symptoms. The findings were reported using unadjusted Odds Ratios (OR) and its 95% confidence interval (CI).

Then a full model including the nutritional (household food insecurity, anaemia, MUAC, fasting, nutrition related knowledge) socio-demographic (age, religion, marital status, family size and wealth index) and other confounders (obstetric factors, acute illnesses, social support, chat chewing practices and intimate partner violence) were fitted using a multivariate binary logistics regression to identify the independent predictors of prenatal depressive symptoms. Adjusted odds ratios (OR) and their 95% CI were presented as indicators of strength of association. A

p-value of 0.05 or less was used to determine the cut-off points for statistical significance.

Results

Characteristics of study participants

All recruited 4680 pregnant women between March 2014 and March 2016 were included in the final analysis. The median age of study participants was 26 years [inter--quartile range (IQR) 22, 30]. More than half of the pregnant women (55.2%) were illiterate and only 241(5.1%) of the respondents had completed secondary education or higher. Just over two-third (67.3%) of the respondents were Muslim and 97.7% were married. Participants' characteristics are presented in Table 1.

Prevalence of prenatal depressive symptoms

A total of 506 pregnant women had a PHQ-9 score ≥ 8, yielding a crude depressive symptom prevalence rate of 10.81% (95% CI: 9.92–11.70). The prevalence of depressed mood in pregnant women is depicted in Table 2. The prevalence was higher among pregnant women age above 35 years (11.8% versus 8.6% for younger women), unmarried (26.9% versus 10.4% for married) and illiterate (11.4% versus 5.0% for secondary school and above). Nearly 13 % of Muslim pregnant women were in depressed mood compared to 6.7% for Orthodox and 6.1% for Protestants and Catholic Christians. The prevalence of prenatal depressive symptoms increased with household food insecurity severity; 34.4% of mothers in severely food insecure households were suffering from depressed mood compared to 4.8% in food secure households ($p < 0.001$). Moreover, the prevalence was higher among anaemic (14.2% versus 9.5% for without anaemia) and under-nourished (12.4% versus 9.7% for well-nourished, $p = 0.005$) pregnant women. The depressive symptoms prevalence increased with gestational age which is 8.7%, 10.2% and 12.0% ($p = 0.039$) for first, second and third trimester respectively. The severity of the depressed mood was also increased with gestational age with mean values of 2.98 (± 3.05), 3.03 (± 3.50) and 3.26 (± 3.61) for the first, second and third trimester respectively. Prenatal depressive symptomatology was more prevalent among mothers who encountered intimate partner violence (29.7% versus 9.8% for mothers with no IPV experience).

Socio-demographic factors

Prenatal depressive symptoms was significantly associated with marital status ($p < 0.001$). Unmarried pregnant women were 2.65 times more likely to develop depressive symptoms than their married counterparts (AOR = 2.65; 95%CI: 1.59–4.44). Pregnant women in households with more than five family size are 1.36 times (AOR = 1.36; 95%CI: 1.08–1.71) more at risk of depressive symptoms than those living in small family size households. Similarly, geographic location was important with women living in some districts being more likely to exhibit depressive symptoms. Pregnant women in Gomma and Tiro-Afeta districts faced 3.04 times (AOR = 3.04; 95%CI: 2.04–4.53) and 2.02 times (AOR = 2.02; 95%CI: 1.34–3.05) higher risk of depressive symptoms than those living in Woliso district. None of the remaining socio-demographic variables shown in Table 2 were associated with an increased prevalence of major depressive symptoms (Table 2).

Nutrition related factors

After adjusting for confounding variables, women with moderate and severe household food insecurity had 1.74 (AOR = 1.74; 95% CI: 1.31–2.32) and 7.90 (AOR 7.90; 95% CI: 5.87–10.62) times higher risk of prenatal depressive symptoms respectively than women who were living in food secure households. Similarly, anaemic pregnant women were at higher risk of prenatal depression than those with normal haemoglobin concentration (AOR = 1.30; 95% CI: 1.04–1.61). Examining the crude odds ratios, we found that prenatal depressive symptoms was positively associated with both undernutrition assessed by low MUAC (AOR = 1.31; 95%CI: 1.09–1.57) and chat chewing (AOR = 1.58; 95%CI: 1.26–2.00). However, this relationship disappeared when adjusted for all other variables in the final model (Table 2).

Intimate partner violence and maternal social support

As shown in Table 2, depressive symptomatology was more likely among participants who encountered higher intimate partner violence (AOR = 3.08; 95%CI: 2.23–4.25) and poor social support from spouse, families and friends (AOR = 1.63; 95%CI: 1.31–2.02).

Discussion

The key contribution of this paper is to show the prevalence of prenatal depressive symptoms and its association with nutrition related factors, intimate partner violence and social support in rural Ethiopia. This finding has important implications, particularly in Ethiopia, where the burden of mental health diseases and intimate partner violence are high, resource allocation towards mental health care is poor with four psychiatrists per 10,000,000 population [27], inadequate nutritional status in pregnancy is still a considerable public health burden and both nutrition and intimate partner violence are modifiable risk factors.

The relationship between IPV, depression and food insecurity are all bidirectional and social support plays a buffering and protective role in this link. Depression is the most common mental health consequences of IPV [28, 29]. Previous studies indicated that women who experience IPV have about four times greater risk of depression than women who do not experience IPV. On

Table 1 Characteristics of the study participants, Ethiopia, 2016

Variables		Number	Percent
Age	Less than 25 years	1615	34.5
	25–35 years	2831	60.5
	Above 35 years	234	5.0
	Median (IQR)	26 (22–30)	
Religion	Muslim	3148	67.3
	Orthodox	1057	22.6
	Protestant & Catholic	472	10.1
	Missing	3	0.1
Marital status	Married	4572	97.7
	Unmarried	108	2.3
Education	Illiterate	2585	55.2
	Primary school	1491	31.9
	Junior secondary school	363	7.8
	Secondary and above	241	5.1
	Median (IQR)	0 (0–4)	
Family size	Less than five	2216	47.4
	Five or more	2464	52.6
	Median (IQR)	5 (3–6)	
Wealth quintile	Lowest	928	19.8
	Second	957	20.4
	Middle	863	18.4
	Fourth	986	21.1
	Highest	934	20.0
Household Food Insecurity	Secure	1600	34.2)
	Mildly insecure	600	12.8
	Moderately insecure	1846	39.4
	Severely insecure	634	13.5
Fasting	Yes	2428	51.9
	No	2252	48.1
Anaemia	Greater or equal to 11 g/dl	3409	72.84
	Less than 11 g/dl	1271	27.2
Mid-upper Arm Circumference (MUAC)	Greater or equal to 23 cm	2771	59.2
	Less than 23 cm	1909	40.8
	Median (IQR)	23.30 (22.07–24.57)	
Chat chewing	Yes	690	14.7
	No	3990	85.3
Nutrition related knowledge	Yes	315	6.7
	No	4365	93.3
Antenatal care (previous pregnancy)	No ANC	1626	34.7
	One to three times	1924	41.1
	Greater than four visits	1859	39.7
Gravidity	Primi-gravida	608	13.0
	Multigravida	1924	41.1
	Grand multigravida	2148	45.9

Table 1 Characteristics of the study participants, Ethiopia, 2016 *(Continued)*

Variables		Number	Percent
Gestational age	First trimester	164	3.5
	Second trimester	2869	61.3
	Third trimester	1647	35.2
History of child death	Yes	1214	25.9
	No	3466	74.1
Previous spontaneous abortion	Yes	539	11.5
	No	4141	88.5
Acute illness	Yes	1203	25.7
	No	3477	74.3
Social participation	Yes	2886	61.7
	No	1794	38.3
	Median (IQR)	1.0 (0–1.0)	
Maternal social support	Good support	2485	53.1
	Poor support	2195	46.9
Intimate partner violence	Yes	232	5.0
	No	4448	95.0

the other hand, depression is associated with the use of hostility, insult, and threat in marital interactions [30, 31]. When we see the pathway between IPV and household food insecurity, previous research demonstrated that it is mediated by depression [32].

Poverty is one of the key contributors to intimate partner violence [33]. Since poverty is inherently stressful, it has been argued that intimate partner violence may result from stress and that poorer men have fewer resources to reduce stress. Poverty as it impairs purchasing power, results in household food insecurity. IPV may affect the couple's capacity to organize the home environment and manage the resources available in order to guarantee the food and nutrition security of the family. Looking this link from household food insecurity side, a broader anthropological conceptualization of food insecurity posits that acute or chronic exposure to periods of food uncertainty can influence mental and physical health outcomes. Social support plays a buffering role for both depressive symptoms and IPV. Social support from family or friends buffers the effects of environmental stressors such as IPV and poverty and could decrease individual's vulnerability to depression [34].

Consistent with previous studies in low, middle and high income countries, this study revealed that household food insecurity is strong predictor of prenatal depressive symptoms [12, 35–38]. Food insecurity by itself is a stressful life event, and the occurrence of stressful events was shown to affect the hypothalamic-pituitary-adrenocortical (HPA) axis. It is also known that hypothalamic dysfunction was linked to the onset and recurrence of depression [39].

Moreover, previous studies indicated that food insecurity was linked to specific nutrient deficiencies, which were also associated with depressive symptoms [16, 40]. These studies showed that food insecurity influences prenatal depression through deficiencies in energy, vitamin B12, Selenium or folic acid. Yet, another study also indicated that low-income women with depressive symptoms and life stressors represent an at-risk group for low diet quality during pregnancy and hence the link between depression and nutrient deficiencies is bidirectional [41]. Using nationally representative data and a number of different modeling approaches, Noonan and colleagues found robust evidence that maternal depression has adverse effects on household food insecurity [42]. Hence, the association between depression and food insecurity is also bidirectional.

In this study, pregnant women with depressive symptoms had lower haemoglobin levels than women without depressive symptoms. In agreement with our findings, previous observational studies generally established that anaemia is associated with depression [13, 43]. However, a placebo and high-iron diet controlled supplementation trial among female participants in high income countries found no association between depression and anaemia [44].

The relationship and direction of the relationship between depression and maternal anaemia remains unclear and still needs further investigation. However, there are different hypotheses about the mechanisms linking anaemia with depression. Iron is a co-factor in synthesis of tyrosine and tryptophan. Tyrosine and tryptophan are precursors for the neurotransmitters dopamine, norepinephrine and serotonin [45]. The traditional monoamine

Table 2 Variables associated with prenatal depressive symptoms, Ethiopia, 2016

Variables		Depressive Symptoms Number (%)	Unadjusted OR (95%CI)	*p-value*	Adjusted OR (95%CI)	*p-value*
Age	Less than 25 years	139 (8.6)	**0.59 (0.39–0.90)**	**0.01**	0.77 (0.47–1.26)	0.294
	25–35 years	335 (11.8)	0.85 (0.57–1.25)	0.41	0.85 (0.55–1.32)	0.474
	Above 35 years	32 (13.7)	1.0		1.0	
Religion	Orthodox	71 (6.7)	0.91 (0.58–1.42)	0.68	0.80 (0.54–1.19)	0.272
	Protestant & Catholic	29 (6.1)	**2.05 (1.58–2.67)**	**< 0.001**	0.85 (0.50–1.45)	0.557
	Muslim	405 (12.9)	1.0		1.0	
Marital status	Married	477 (10.4)	1.0		1.0	
	Unmarried	29 (26.9)	**3.15 (2.04–4.87)**	**< 0.001**	**2.65 (1.59–4.44)**	**< 0.001**
Education	Primary or below	465 (11.4)	**1.77 (1.27–2.46)**	**< 0.001**	1.07 (0.74–1.56)	0.707
	Above primary	41 (6.8)	1.0		1.0	
Family size	Less than five	198 (8.9)	1.0		1.0	
	Five or more	308 (12.5)	**1.46 (1.21–1.76)**	**< 0.001**	**1.36 (1.08–1.71)**	**0.010**
Wealth index	Lowest	90 (9.7)	0.81 (0.60–1.08)	0.148		
	Second	125 (13.1)	1.13 (0.86–1.48)	0.397		
	Middle	78 (9.0)	0.74 (0.55–1.01)	0.059		
	Fourth	103 (10.4)	0.87 (0.66–1.16)	0.354		
	Highest	110 (11.8)	1.0			
Address	Gomma	209 (13.4)	**2.26 (1.76–2.90)**	**< 0.001**	**3.04 (2.04–4.53)**	**< 0.001**
	Tiro-Afeta	197 (12.6)	**2.11 (1.64–2.71)**	**< 0.001**	**2.02 (1.34–3.05)**	**0.001**
	Woliso	100 (6.4)	1.0		1.0	
Household Food Insecurity	Secure	76 (4.8)	1.0		1.0	
	Mildly insecure	29 (4.8)	1.02 (0.66–1.56)	0.309	0.84 (0.54–1.31)	0.445
	Moderately insecure	183 (9.9)	**2.21 (1.67–2.91)**	**0.001**	**1.74 (1.31–2.32)**	**< 0.001**
	Severely insecure	218 (34.4)	**10.51(7.92–13.94)**	**< 0.001**	**7.90 (5.87–10.62)**	**< 0.001**
Fasting	Yes	256 (10.5)	1.0			
	No	250 (11.1)	1.06 (0.88–1.27)	0.539		
Haemoglobin Concentration	11 g/dl or more	325 (9.5)	1.0		1.0	
	Less than 11 g/dl	181 (14.2)	**1.58 (1.30–1.91)**	**< 0.001**	**1.30 (1.04–1.61)**	**0.019**
Mid-upper Arm Circumference (MUAC)	Greater or equal to 23 cm	270 (9.7)	1.0		1.0	
	Less than 23 cm	236 (12.4)	**1.31 (1.09–1.57)**	**0.005**	0.96 (0.78–1.18)	0.692
Chat chewing	Yes	104 (15.1)	**1.58 (1.26–2.00)**	**< 0.001**	0.94 (0.72–1.23)	0.638
	No	402 (10.1)	1.0		1.0	
Nutrition Related knowledge	Yes	43 (13.7)	1.0			
	No	463 (10.6)	0.75 (0.54–1.05)	0.094		
Maternal social support	Good support	185 (7.4)	1.0		1.0	**< 0.001**
	Poor support	321 (14.6)	**2.13 (1.76–2.58)**	**< 0.001**	**1.63 (1.31–2.02)**	
Intimate partner violence	Yes	69 (29.7)	**3.38 (2.59–4.42)**	**< 0.001**	**3.08 (2.23–4.25)**	**< 0.001**
	No	437 (9.8)	1.0		1.0	

hypothesis of depression speculates that low dopamine, norepinephrine, and serotonin concentrations may result in depression [46]. In addition, iron is a cofactor for the reaction leading to the production and secretion of glutamate [47]. The glutamate hypothesis of depression has posited that dysregulation of the glutamatergic system results in depression [48].

In congruence with other previous studies, we found a statistically significant association between intimate partner violence and prenatal depressive symptoms [14, 15, 49].

Because of fear of stigmatization, battered women often experience feelings of shame, isolation and entrapment and did not communicate openly to others that violence occurred to them by their spouses [50]. This results in lack of support from friends and families and rather leads to more depression.

Respondents with prenatal depressive symptoms reported poorer maternal social support compared to their counterparts. Our finding is consistent with the suggestion that social support may safeguard the adverse effects of prenatal psychological distress on birth outcomes [51, 52]. The buffering hypothesis of social support postulated that the potential pathogenic effect of stressful events is reduced when support is accessible [53].

The prevalence of depressive symptoms during pregnancy in our study was lower compared to previous prevalence reports in Ethiopia [4–7, 54]. The relatively lower prevalence in our study probably reflects the fact that this is a population based study while the prior studies were health facility based. It could be postulated that the difference in rates could be due to different population sub-groups, for example in the health facility based studies, respondents are likely to be medical patients who may be reporting somatic symptoms (e.g. fatigue and anorexia) that might be confounded by the underlying condition that the patients are seeking care. Spitzer et al. [55] recommended that tools with questions about appetite, fatigue, or sleep (e.g., PHQ-9) must be interpreted cautiously, as impairment might reflect the physical effect of pregnancy rather than depressive symptoms.

We found a statistically significant difference in prenatal depressive symptoms prevalence among the three study districts with the lowest prevalence found in Woliso. Worldwide estimates of depressive symptoms vary widely between studies and settings, discrepancies being attributable to real differences between countries but also to the method of assessment [56]. Previous studies in Ethiopia reported a differential prenatal depressive symptoms prevalence by study sites [4–7]. Each of these studies used different tools to screen depressive symptoms.

Adjusting for relevant confounding variables, we found that marital status, geographical location, family size, household food insecurity and anaemia were identified as predictors of prenatal depressive symptoms. The association between marital status and prenatal depressed mood is consistent with a number of studies in low, middle and high income countries where they found higher rates of mental distress in the widowed, separated and divorced women in comparison with married women [57, 58]. However, other general population studies reported no association [59, 60].

The main strength of this study lies in access to community based data to describe prevalence and associated risk factors of depressive symptoms during pregnancy. This study is also based on large sample size and huge response rate; a very thorough description of the population with a big number of questionnaires on different socio-demographic, nutritional and other clinical risk factors. Being a cross-sectional analysis, the usual restrictions inherent to cross-sectional and observational studies apply here; no information about causality. An additional limitation of this study is that we used one month recall on the food-insecurity measure, but a two weeks recall on the measure of depressive symptoms, which raises concerns over the reported associations.

Conclusions

Prenatal depressive symptomatology is quite common during pregnancy. Socio-demographic factors such as marital status, family size and geographical location are associated with an increased prevalence of prenatal depressive symptoms. Similarly, nutrition related factors such as household food insecurity and anaemia are associated with prenatal depression. While social support from friends, families and spouse during pregnancy are protective, intimate partner violence augments prenatal depression.

The implications of our study for practice are to emphasize the need for targeted screening for intimate partner violence and depressive symptoms during pregnancy and to link cases to health facilities where treatment is available. In this regard we recommend the Ethiopian Ministry of Health to integrate screening of depressive symptoms and intimate partner violence in routine antenatal care services. Policies aimed at reducing household food insecurity, maternal anaemia, intimate partner violence and promoting maternal social support are likely to have a significant public health impact in preventing prenatal depression. Organizing a mental health team, including health extension workers, in antenatal services to screen and treat prenatal depression together with the aforementioned risk factors during pregnancy might prevent or ameliorate prenatal depression.

Abbreviations

CI: Confidence Interval; HITS: Hurt, Insult, Threaten and Scream; IPV: Intimate Partner Violence; LMIC: Lower-Middle-Income Countries; MSS: Maternal Social support; MDD: Major depressive disorder; MUAC: Mid upper arm circumference; OR: Odds Ratio; PHQ-9: Patient health questionnaire-9; PUFA: Polyunsaturated fatty acids; SPSS: Statistical Package for the Social Sciences; USAID: United States Agency for International Development

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Availability of data and materials
The data that support the findings of this study are available from Tufts and Jimma Universities but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Tufts and Jimma Universities.

Authors' contributions
YK designed/implemented the study, analyzed the data and drafted the manuscript; SG & TB designed/implemented the study and critically reviewed the final version of the manuscript; VS, EK, MEL & HKB assisted data analysis and critically reviewed the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate
The study was conducted in accordance with the WHO's ethical and safety recommendations for research on domestic violence against women [61]. The main principals to justify this research were also fulfilled according to the World Medical Association Declaration of Helsinki [62]. During data collection, all measures were taken to ensure that women could get support if it was deemed necessary. Study participants who were screened positive for depressive symptoms or IPV were referred to a nearby health facility for possible social and medical support. Ethical clearance was obtained from Jimma University ethical review board.
Informed written consent was obtained from all individual participants included in the study. All interviews were conducted in private and confidentiality was ensured for each study participants. Study participants who were screened suffering from IPV were referred to Jimma University Hospital for social and psychological care.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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5

Chapter 5

The Effect of Maternal Depressive Symptoms on Infant Feeding Practices in Rural Ethiopia: Community Based Birth Cohort Study

The Effect of Maternal Depressive Symptoms on Infant Feeding Practices in Rural Ethiopia: Community Based Birth Cohort Study

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Abstract

Background: *Infant feeding is a multidimensional and multi-risk factor practice with a vital role in ensuring optimal child health, growth and development. Maternal depressive symptoms have been shown to have adverse consequences on feeding practices. However, most of these findings were based on single infant feeding practice (IFP) dimension; e.g. early initiation of breastfeeding, exclusive breastfeeding or introduction of complementary foods. This study aims to explore the longitudinal relationship between maternal depressive symptoms and IFPs in rural Ethiopia using summary IFP index.*

Methods*: This study uses existing data from the ENGINE birth cohort study. The study had an open cohort design, with rolling recruitment and follow up of pregnant women for a period of two years. It was conducted from March 2014 to March 2016 in three districts (Woliso, Tiro-Afeta and Gomma) in the southwest of Ethiopia. The sample size was 4680 with pregnant women recruited between 12 and 32 weeks of gestation. Data were collected once during pregnancy for all women (twice for those in the first trimester), at birth, and then every three months until the child was 12 months old. Data collection was conducted by trained nurses electronically using Open Data Kit (ODK) software. A composite measure of IFP index was computed using 14 WHO recommended infant and young child feeding (IYCF) practice indicators. Maternal depressive symptoms (prenatal and postnatal) were assessed using the patient health questionnaire (PHQ-9). Linear multilevel mixed effects model was fitted to assess longitudinal relationship of IFPs and maternal depression.*

Results*: Early postnatal depressive symptoms were inversely and significantly associated with IFPs (ß= -1.031, P=0.001). However, prenatal maternal depression was not significantly associated with IFPs (ß= -0.024, P=0.953). Similarly, intimate partner violence (ß= -0.208, P=0.001) was negatively associated with IFPs. On the other hand, maternal social support (ß= 0.107, P=0.002) and maternal social participation (ß= 0.552, P<0.001) were positively associated with IFPs. Maternal education and gestational age at birth were other important factors positively associated with IFPs. Moreover, contrary to expected, moderate household food insecurity (ß= 0.836, P=0.003), severe household food insecurity (ß= 1.034, P=0.01) and infant morbidity episodes (ß= 0.625, P=0.013) were positively associated with IFPs.*

Conclusion*: Early postnatal depressive symptoms and intimate partner violence were negative predictors of IFPs. On the other hand, maternal education, gestational age at birth, maternal social support and social participation are positive predictors of IFPs. Overall, we conclude that a multitude of factors are related to IFPs and hence coordinated, multi-sectoral and multi-stakeholder interventions including maternal depressive symptoms screening and management are needed to improve IFPs.*

Key words*: Infant feeding practices, prenatal depression, postnatal depression, household food insecurity, intimate partner violence, social support, Ethiopia*

Background

According to recent WHO reports, significant global progress has been made in reducing child mortality since 1990 [1]. The global under-5 mortality rate has dropped by 59% between 1990 and 2018. However, there are still disparities in under-5 mortality across regions and countries. Sub-Saharan Africa remains the region with the highest rate in the world. Half of all under-five deaths in 2018 occurred in just five countries: India, Nigeria, Pakistan, Ethiopia and the Democratic Republic of the Congo. Nutrition-related factors contribute to about 45% of deaths in children under-5 years of age [1].

Nutritional deficits during the first 2 years of life are associated with stunting, leading to the adult being shorter than his or her potential height [2]. Adults who were malnourished in early childhood have been found to have impaired intellectual performance, delayed childhood development, reduced capacity for physical work, reduced reproductive capacity and more complicated deliveries in women [3–7]. The first two years of life is also a critical window of opportunity for prevention of growth faltering and undernutrition through prevention of low birth weight and appropriate IFPs [8].

As the 2005 Innocenti Declaration on IYCF recognized, appropriate feeding practice during infancy and early childhood is vital for ensuring optimal child health, growth and development [9]. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) set a global strategy for optimal IYCF [10].The Ministry of Health of Ethiopia has also developed and implemented the IYCF guidelines in 2004 [11]. However, IYCF practices are still suboptimal throughout the globe; particularly in Ethiopia [12–17].

According to social cognitive theory [18], factors influencing IFPs can be broadly categorized into internal personal and socio-environmental factors. Internal personal factors include cognitive/affective (knowledge, attitudes and beliefs), outcome expectations (best for infant), self-efficacy (confidence and previous experience), biological (for example mothers age) or psychosocial (comfort with breastfeeding in public). Socio-environmental factors include institutional (health care practice, policy etc.), social (family support/dynamics), socio-demographic (education, income ethnicity), physical (fatigue, pain etc.) and others (cost, availability and the like). Several previous studies focused on exploring those associations [19–22]. There are limited literature suggesting that maternal depression could lead to poor infant feeding practices, consequently leading to malnutrition and reduced physical growth [23–25].

However, very little attention has been paid to explore maternal depression influence on infant feeding practices, especially in rural communities.

Infant and young child feeding practices are multidimensional, age specific and are more likely to cluster as mothers who early initiate breastfeeding and exclusively breastfeed will also be more aware of recommended optimal complimentary feeding [26]. However, most previous research on feeding practices has focused on only one or two dimensions at a time leading to fragmented information and blurred and inconsistent overall feeding patterns. Child feeding indices have the potential to handle such challenges. Child feeding index is a composite indicator which allows to measure IYCF practices in their entirety [27–29]. Reinbott et al. reported that a child feeding index is superior to WHO IYCF indicators in explaining length-for-age Z-scores of young children [30]. However, use of IYCF indices has gained impetus only after early 2000's and to the authors best knowledge there is no study that utilize IFP indices to explore the effect of maternal depression on IFP scores. Thus, the main objective of this study is to determine the longitudinal association of maternal depressive symptoms and IFPs in rural Ethiopia using summary IFP indices.

Methods

This manuscript is based on ENGINE birth cohort study data. The ENGINE birth cohort study is a prospective, community-based study within Empowering New Generations to Improve Nutrition and Economic opportunities (ENGINE) program. ENGINE was a USAID funded five years nutrition intervention program implemented from September 2011 to September 2016 in 100 selected districts in rural Ethiopia. Its main goal was to improve nutritional status of mothers' and young children through a multi-sectoral approach targeting health, nutrition and agriculture. The ENGINE birth cohort study was led by Tufts University and aimed to investigate the benefits of an integrated nutrition program and its co-location with agricultural growth program on household agricultural production and productivity, food security, diet diversity, socio-economic status and livelihoods, as well as health and nutritional status of mothers and their children.

The study had an open cohort design, with rolling recruitment and follow up of pregnant women for a period of two years. It was conducted from March 2014 to March 2016 in three Districts (Woliso, Tiro-Afeta and Gomma) in the South Western part of Ethiopia. The total sample size for this study was 4680 pregnant women recruited between 12 and 32 weeks of gestation. Data were collected once during pregnancy for all women (twice for those in the first trimester), at birth, and then every three months

until the child was 12 months old. Data collection was conducted by trained nurses electronically using Open Data Kit (ODK) software on handheld tablets and submitted to a secured server via an internet connection.

Measurement

Infant Feeding Practices (IFPs): Infant feeding index was constructed using data collected at birth and then every three months until 12 months of age. Mothers were asked about timing of breastfeeding initiation, colostrum feeding, anything given to the infant before giving breast milk, number of times the infant was breastfed during the day and night, whether the infant was still breastfed, and what the infant ate yesterday. Based on these information, five separate IFP indices were prepared to assess age-specific infant feeding practices; namely, within three days of birth, at three months, six months, nine months and 12 months of child age.

The indices were computed following the methods suggested by Ruel and Menon [29]. Each item was scored depending on whether a practice was appropriate based on the WHO infant feeding recommendations [17,31]. A practice that was appropriate for a specific age group received a score of 1, and a practice that was inappropriate received a score of 0. Practices that are considered particularly relevant for a given time point received a score of 2 or 3. For example, breastfeeding received a score of 2 for an infant from birth to 12months of age. A score of 0 was given to non-breastfed infants. Use of bottle with a nipple was scored as 0 because the practice is considered inappropriate for all age groups; avoidance of infant bottles received a score of 1, indicating an appropriate practice. The dietary diversity score was calculated by adding the number of food groups consumed in the last 24 hours and received a score of 0 if the child got below three food groups, 1 if the child got three food groups or scored 2 if the child got four or more than four food groups in the past 24 hours (Table 1).

The unstandardized total score could reach a maximum of 9-15 scoring points depending on the time point. The indices were standardized by converting each score into percentage of the maximum total score of the scales at each time point. A higher score in the feeding scales indicated a better infant feeding practice. The index was treated as continues variable. Table 1 below depicts the infant feeding practice variables and scoring system used in this paper.

Table 1. Feeding practice variables and scoring system used to construct the infant feeding practice index, Ethiopia, 2019

IYCF Indicators	Scoring				
	Birth	3 months	6 months	9 months	12 months
Timely Initiation of breastfeeding	0 = after one day 1 = within 24 hour 2= within an hour				
Prelacteal feeding	0 = Yes 1 = No				
Colostrum feeding	0 = No 1= Yes				
Exclusive breastfeeding	0 = No 2 = Yes	0 = No 2 = Yes			
Frequency of breastfeeding	0 = No breastfeeding 1 = less than 8 times 2 = 8-11 times 3 = ≥ 12 times	0 = No breastfeeding 1 = less than 8 times 2 = 8-11 times 3 = ≥ 12 times	0 = No breastfeeding 1 = less than 8 times 2 = 8-11 times 3 = ≥ 12 times	0 = No breastfeeding 1 = less than 8 times 2 = 8-11 times 3 = ≥ 12 times	0 = No breastfeeding 1 = less than 8 times 2 = 8-11 times 3 = ≥ 12 times
Continued Breastfeeding at one year	0 = No 1 = Yes	0 = No 1 = Yes	0 = No 1 = Yes	0 = No 1 = Yes	0 = No 1 = Yes
Bottle feeding	0 = Yes 1 = No	0 = Yes 1 = No	0 = Yes 1 = No	0 = Yes 1 = No	0 = Yes 1 = No
Introduction of solid/semi-solid/soft food	0 = Yes 1 = No	0 = Yes 1 = No	0 = No 2 = Yes	0 = No 2 = Yes	0 = No 2 = Yes
Minimum dietary diversity				0 = less than 3 food types 1 = only 3 food types 2 = 4 & more food types	0 = less than 3 food types 1 = only 3 food types 2 = 4 & more food types
Minimum meal frequency				0 = no food taken 1 = 1-2 times a day 2 = 3 or more times	0 = no food taken 1 = 1-2 times a day 2 = 3 or more times
Minimum acceptable diet				0 = No 1 = Yes	0 = No 1 = Yes
Consumption of iron rich food				0 = No 1 = Yes	0 = No 1 = Yes
On demand BF	0 = No 1= Yes	0 = No 1= Yes	0 = No 1= Yes	0 = No 1= Yes	0 = No 1= Yes
Active feeding			0 = No 1= Yes	0 = No 1= Yes	0 = No 1= Yes
Potential score	0-13	0-9	0-9	0-15	0-15

Maternal depressive symptoms: Maternal depressive symptoms were assessed using validated 9 items patient health questionnaire (PHQ-9) two times during pregnancy, within 72 hours after birth and three months postpartum. The PHQ-9 is a 9-item self-administered questionnaire designed to evaluate the presence of depressive symptoms during the prior two weeks. The nine items of the PHQ-9 are based directly on the nine diagnostic criteria for major depressive disorder in the DSM-IV (Diagnostic and Statistical Manual Fourth Edition) [32]. Each of the nine items can be scored from 0 (not at all) to 3 (nearly every day). Thus, total score can range from 0 (absence of depressive symptoms) to 27 (most severe depressive symptoms).

This instrument had been validated for Afaan Oromo Language in a similar population prior to the commencement of the ENGINE birth cohort study and possessed good psychometric properties. A PHQ-9 score of 8 or above was taken as a cut off to define depressive symptoms [33]. For this study maternal depressive symptoms were classified as prenatal, postnatal (immediately after birth and three months postpartum) and persistent. Persistent depressive symptoms were defined as mothers screened positive for depressive symptoms during all the three assessment periods; pregnancy, at birth and three

months postpartum. As there were very few mothers with persistent depression, only the prenatal and postnatal depressive symptoms (measured during pregnancy and within three days of birth) were included in the final model.

Household Food Insecurity: The household food insecurity was measured using the Household Food Insecurity Access Scale [34] at baseline (recruitment), at infants 6 months and 12 months of age. For this article we used the baseline measurement. The index women were asked nine questions (yes/no) to determine if anyone in their household had experienced problems of food access over four weeks preceding the interview. An affirmative response to any of the nine questions was followed by a question to determine how often the condition happened: rarely (1-2 times), sometimes (3-10 times), and often (> 10 times). Responses were coded as 0 = never (i.e., no experience), 1= rarely, 2 = sometimes, or 3 = often. Household food insecurity was categorized into four severity levels: food secure, mildly food insecure, moderately food insecure, and severely food insecure as per the algorithm described by Coates et al [34].

Intimate Partner Violence (IPV): A screening tool called HITS (Hurt, Insult, Threaten and Scream) was applied to assess intimate partner violence. Three of HITS items (insult, threat and scream) measure the emotional (psychological) aspects of intimate partner violence and the first item (hurt) measures physical violence. Each item was scored on a scale of 1 (never) to 5 (frequently) and later the sum score was computed. The score was treated as a continuous variable in this study.

Maternal Social Support: Maternal Social support was measured using the Maternity Social Support Scale (MSSS) developed by Webster and colleagues [35]. The scale contains six items. Each item has measured on a five-point Likert scale and a total score of 30 was possible. Similarly, the score was treated as continuous variable in this study.

Social participation: Mothers reported (yes/no) whether they were participating in any of the following six social institutions or groups at the time of interview: farmers' groups, women's groups, religious groups, youth groups, health related or well-being groups, and Kebele committee (administration, saving, and credit, and other groups). The total number of social institutions in which households participated was computed and then dichotomized as: 0 = did not participate-in any of the six social institutions and 1= participated-in at least one social institution.

Statistical Analysis

We examined whether missing data on feeding practices and maternal depressive symptoms differed from those who were not missing these data. We compared these two groups on infants' birth weight, household food security, and other key baseline sociodemographic variables. For the continuous variables, we used a t test for equality of means; and for the categorical variables, we used Pearson's chi-square tests.

Participants' characteristics, IFPs and maternal depressive symptoms were summarized using descriptive statistics. To assess longitudinal relationship of infant feeding practice (IFP) and maternal depressive symptoms, we assumed that the repeated measurements of IFPs taken from each infant, overtime, are correlated and it is expected that study participants changed feeding practices over time as infants gets older. To examine differences in IFP within individual subjects over the follow up period, a linear multilevel mixed effects (fixed effects and random effects) model with a random intercept and a random slope was fitted with maximum likelihood estimation method. The fixed effects describe a population intercept and population slopes for a set of covariates, which include exposures and potential confounders. Random effects describe individual variability in IFP and changes over time. By considering individual random slopes and intercepts, this model allows to examine the influence of covariates on the change in IFP over time. Subjects with data from at least two assessment intervals were included in the analysis.

Results

Missing data and attrition: A total of 4,680 pregnant women were recruited and followed-up between March 2014 and March 2016. Of these, 1090 study participants (23.3%) were lost to follow-up between recruitment and 12 months' post-partum. The most lost to follow up (47.7% of the total lost to follow) occurred at time point three. The main reasons for the lost to follow-up were still-births (3.3%), infant death unrelated to the study (3.0%), twin pregnancy (1.3%), abortion (0.9%) and others such as relocation, refusal to continue participation, and absence during data collection after three repeated trial (6.7%).The data collection was stopped before 378 (8.1%) of the infants reached 12 months of age and hence time point seven data missed for these participants. Potential biases related to missing data were assessed based on infant and maternal demographic and socio-economic characteristics. Study participants with missing data on maternal depression and IFPs did not differ from participants with complete data on basic socio-demographic or other study variables.

Characteristics of the study participants: Characteristics of the study participants are presented in Table 2 below. The median age of study participants at the time of recruitment was 26 years [inter-quartile range (IQR) 22, 30]. More than half of the pregnant women (55.2%) were illiterate and only 241(5.1%) of the respondents had completed secondary education or higher. Just over two-third (67.3%) of the respondents were Muslim and 97.7% were married. The infant girls were slightly higher than boys in number. Over 95% of the infants were normal birth weight (weigh greater than 2.5kg), however, more than a third of them were born preterm. In terms of morbidity, 57.5% of babies were ill at least once during the infancy period.

Only 39.7% of mothers had had four plus ANC visits and about one fifth of mothers had suffered birth complication during the current birth. More than 30% of the infants were born at home. Moreover, 25.9% and 11.5% of mothers reported a history of past child death and spontaneous abortion respectively. Only 34% of the study participants live in food secure households. About 8.9avfbg % of mothers reported intimate partner violence during time point three (within three days of birth) interview. Whereas, 56.2% mothers feel they have good social support and 61.7% of mothers reported active social participation.

Table 2: Characteristics of study participants, Ethiopia, 2019

Variables		Number	Percent
Maternal age	Less than 25 years	1615	34.5
	25 – 35 years	2831	60.5
	Above 35 years	234	5.0
	Median (IQR)	26(22-30)	
Religion	Orthodox	1057	22.6
	Protestant & Catholic	472	10.1
	Muslim	3148	67.3
Maternal educational status	Illiterate	2585	55.2
	Primary	1491	31.9
	Junior	363	7.8
	Secondary & above	241	5.1
Marital status	Married	4572	97.7
	Unmarried	108	2.3
Infants gender	Male	2252	49.7
	Female	2276	50.3
Birth weight	Normal birth weight	3972	95.6
	Low birth weight	183	4.4
Gestational age at birth	Preterm	1442	34.7
	Term	2717	65.3
Child illness during the infancy period	Yes	2690	57.5
	No	1990	42.5
Antenatal care	No ANC	1626	34.8
	1-3 ANC visits	1194	25.5
	4 plus visits	1859	39.7
Place of delivery	Health facility	2934	66.4

Variables		Number	Percent
	TBA	75	1.7
	Home	1345	30.4
	Other	66	1.5
Birth complication	Yes	927	19.8
	No	3753	80.2
History of spontaneous abortion	Yes	539	11.5
	No	4140	88.5
History of child death	Yes	1213	25.9
	No	3466	74.1
Intimate partner violence	Yes	417	8.9
	No	4263	91.1
Maternal social support	Good	2631	56.2
	Poor	2049	43.8
Maternal social participation	Yes	2886	61.7
	No	1794	38.3
Household food insecurity	Secured	1600	34.2
	Mildly insecure	600	12.8
	Moderately insecure	1846	39.4
	Severely insecure	634	13.5
Wealth index	Lowest	928	19.8
	Second	957	20.4
	Middle	863	18.4
	Fourth	986	21.1
	Highest	934	20.0

Infant feeding practices: Patterns of IFPs are presented in Table 3 below. Nearly three-fourth (72.5%) of mothers initiated breastfeeding within an hour of birth and majority of them (87.4%) gave colostrum to their infants. Prelacteal feeding was reported only for 36 infants (0.9%). Exclusive breastfeeding prevalence within three days of birth and at three months postpartum were 4097 (97.2%) and 2936 (89.3%) respectively. At infants' age of 6months, 993 (34.3%) infants were still exclusively breastfed. The study shows that few infants were still exclusively fed only breast milk at 9 and 12 months of age. We found that applying only the WHO recommendation of 24 hours recall for exclusive breastfeeding assessment is rather misleading. Using the 24-hour recall methods, the prevalence of exclusive breastfeeding was 14.6% (n=683) and 11.3% (n=530) at 9 and 12 months of age respectively. However, when plausibility was checked against introduction of solid and semi-solid food and exclusivity during the previous assessments, this prevalence reduced to 1.6% (n=64) and 0.1% (n=3) at 9 and 12 months in that order. Frequency of breastfeeding was optimal (8 times and above a day) for majority of the study participants (73.3% - 91.6%) throughout the infancy period.

Only 1,707 (42.1%) of infants were given complementary foods at six months of age. Overall, 90.2% and 95.7% of infants at 9 and 12 months of age respectively were on complementary feeding. Few mothers started complementary feeding early; immediately after birth (0.2%) and at three months postpartum (5.2%).

Table 3: Infant Feeding Practices Status, Ethiopia, 2019

Infant Feeding Practices Indicators			Number	Percent
Core indicators				
Timely Initiation of breastfeeding		Within an hour	3031	72.5
		Within 24 hours	1048	25.1
		After one day	100	2.4
Exclusive breastfeeding		Within 3 days of birth	4097	97.2
		3 months	2936	89.3
Continued Breastfeeding at one year			3531	99.6
Introduction of solid/semi-solid/soft food		Within 3 days of birth	8	0.2
		3 months	217	5.2
		6 months	1707	42.1
		9 months	3605	90.2
		12 months	3442	95.7
Minimum dietary diversity		6 months	13	0.8
		9 months	27	0.7
		12 months	88	2.6
Minimum meal frequency		6 months	1405	82.5
		9 months	1914	53.1
		12 months	2158	62.7
Minimum acceptable diet		6 months	4	0.4
		9 months	12	0.3
		12 months	16	0.3
Consumption of iron rich food		6 months	4	0.2
		9 months	12	0.3
		12 months	16	0.3
Optional indictors				
Frequency of breastfeeding at:	Within three days of birth	<8 times a day	1007	24.6
		8-11 times a day	1880	46.0
		>=12 times a day	1200	29.4
	3 months	<8 times a day	340	8.3
		8-11 times a day	1802	44.2
		>=12 times a day	1935	47.5
	6 months	<8 times a day	470	11.8
		8-11 times a day	1753	44.0
		>=12 times a day	1766	44.3
	9 months	<8 times a day	624	15.9
		8-11 times a day	1907	48.5
		>=12 times a day	1397	35.6
	12 months	<8 times a day	864	24.6
		8-11 times a day	1669	47.5
		>=12 times a day	976	27.8
Colostrum feeding			3653	87.4
Prelacteal feeding			36	0.9
Bottle feeding		Within 3 days of birth	136	3.1
		3 months	635	15.2
		6 months	1394	34.4
		9 months	1406	35.2
		12 months	992	27.6
On demand BF		Within 3 days of birth	3280	78.3
		3 months	2662	64.4
		6 months	2189	54.4
		9 months	1765	44.6
		12 months	1321	37.3
Active feeding		6 months	972	56.9
		9 months	2114	58.6
		12 months	2050	59.6

Grains, roots and tubers were the most common eaten food groups by the infants with a prevalence of 26.1%, 84.8% and 89.9% at 6, 9 and 12 months of age respectively. Dairy products are the second common food group mothers use to start complementary feeding (11.5%) next to grains, roots and tubers and its consumptions decreases as the child gets older (8.9% and 5.0% at 9 and 12 months respectively). Fleshy foods are the least consumed food groups throughout the infancy period. We found that only 10(0.6%), 16 (0.4%) and 64 (1.9%) of infants received the recommended diversified diet. However, the minimum meal frequency was achieved by majority of infants. Among those infants who had already started complementary feeding, 1405 (82.5%), 1914 (53.1%) and 2158 (62.7%) of them had received the minimum meal frequency of WHO recommendation at 6, 9 and 12 months of age respectively.

As indicated in Table 3, the proportion of mothers using bottle to feed their infants continuously increased from birth to 9 months and gets lower at year one. Responsive feeding shows slight increment between 6 and 12 months of infants' age (56.9% - 59.6%).

Maternal depressive symptoms prevalence: Among women who screened for depressive symptoms, cumulative incidence proportions were 10.8%, 18.5% and 7.5% during pregnancy, within three days after birth and three months' post-partum, respectively. Overall, 1156 (26.2%) of mothers had depressive symptoms at least once during the period between recruitment and 3 months' post-partum and 56 respondents (1.2%) were having depressive symptoms persistently during the three measurement times. PHQ-9 mean scores (standard deviation) during the three occasions were 3.11 (4.53), 4.35 (4.04) and 2.13 (3.20) respectively.

Longitudinal relationship of IFP and maternal depression: Based on the standardized composite indices of IFP, the poorest IFP practice occurred at 6 months of infancy (only 54% of the potential score). The practice was better during the first 6 months than the second half of the infancy period (Table 4).

Table 4. Descriptive statistics of infant feeding practices by infants' age, Ethiopia, 2019

Time Point	Subject	Potential Score	Mean, SD (Range)	
			Unstandardized	Standardized
Birth	4023	0-13	10.4 ± 1.1 (5-13)	79.7 ±8.6 (38.5-100)
3 months	3120	0-9	7.3 ± 1.5 (2-9)	81.5 ±17.0 (22.2-100)
6 months	3987	0-10	5.4 ±1.3 (2-10)	53.9±12.9 (20.0-100)
9 months	3543	0-15	8.5 ±1.3 (5-14)	56.5 ±8.9 (33.3-93.3)
12 months	3355	0-13	7.4 ±1.2 (4-12)	56.7±9.6 (30.8-92.3)

As presented in Table 5, linear mixed effects model showed that early postnatal maternal depressive symptoms was negatively associated with IFPs (ß= -1.031, P=0.001).

Table 5. Multilevel model results of the association between infant feeding practices and maternal depressive symptoms and other predictors, Ethiopia, 2019

Factors		Estimates	95% CI		P-value	SE
Maternal age		0.010	-0.036	0.057	0.66	0.024
Mother Education	Illiterate					
	Primary	0.787	0.240	1.333	**0.005**	0.279
	Secondary & above	1.357	0.567	2.146	**0.001**	0.403
Religion	Orthodox					
	Protestant & Catholic	1.497	0.548	2.447	**0.002**	0.484
	Muslim	-2.587	-3.209	-1.965	**<0.001**	0.317
Wealth index		-0.007	-0.073	0.060	0.844	0.034
Household food security	Secured					
	Mildly insecure	-0.692	-1.458	0.073	0.076	0.391
	Moderately insecure	0.836	0.293	1.380	**0.003**	0.277
	Severely insecure	1.034	0.251	1.816	**0.01**	0.399
Maternal social support		0.107	0.041	0.174	**0.002**	0.034
Social participation		0.552	0.298	0.806	**<0.001**	0.129
Intimate partner violence		-0.208	-0.337	-0.080	**0.001**	0.065
Prenatal Depression	Yes	-0.024	-0.802	0.755	0.953	0.397
	No					
Postnatal Depression (within 3 days of birth)	Yes	-1.031	-1.647	-0.414	**0.001**	0.314
	No					
Child gender	Male					
	Female	-0.128	0.580	0.326	0.58	0.232
Gestational age at birth		0.517	0.035	0.998	**0.036**	0.246
Antenatal care visits	No ANC					
	1-3 ANC visits	-0.418	-1.023	0.186	0.175	0.309
	4 plus visits	0.261	-0.325	0.847	0.382	0.299
Child illness	Yes	0.625	0.134	1.117	**0.013**	0.251
	No					
Constant		67.389	64.723	70.054	<0.001	1.360
Random-effects						
Variance of random intercept		7.208	6.971	7.453		0.123
Variance of random slope		24.743	23.741	25.789		0.522
Covariance of random intercept and slope		-0.998	-0.999	-0.994		0.001
Variance of measurement errors		13.29416	13.0983	13.4928		0.1006

SE = standard error

However, prenatal maternal depressive symptoms was not associated with IFPs (ß= -0.024, P=0.953). Similar to early postnatal depressive symptoms, intimate partner violence was negatively associated with IFPs (ß= -0.208, P=0.001). On the other hand, maternal social support (ß= 0.107, P=0.002) and social participation (ß= 0.552, P<0.001) were positively associated with IFPs. Compared with Orthodox Christians, Protestant and Catholic Christians have better (ß= 1.497, P=0.002) but infants from Muslim families have poorer IFP scores (ß= -2.587, P<0.001). Contrary to expected, mild household food insecurity (ß= 0.836, P=0.003), severe household food insecurity (ß= 1.034, P=0.01) and infant morbidity episodes (ß= 0.625, P=0.013) were positively associated with IFPs. Maternal education and gestational age at birth were other important factors positively associated with IFPs in this study.

Discussion

In this study we examined the association between maternal depressive symptoms and IFPs using a computed index suggested by Ruel and Menon [29]. The key contribution of this study is to show the effect of maternal depressive symptoms on IFPs in rural Ethiopia. The findings have important implications for policy makers, researchers, donors and program implementers working on child nutrition in Ethiopia, where the burden of child malnutrition is the highest [14].

The IFPs score is relatively higher during the first 6 months than the second 6 months of age. During the first six months, IFP components need no significant additional costs for rural Ethiopian women but mothers' commitment and knowledge. However, during the second six months of the infancy period, the IFP components need resources particularly to fulfill the required quality of meal and the frequency. As revealed in this study, less than three percent of infants received a quality diet as measured by dietary diversity. Several previous studies in Ethiopia came up with similar findings of unacceptably low percentage of infant dietary diversity [36–39]. Moreover, we found that the IFP score was the poorest particularly at six months of age. This might be explained by the small proportion of mothers who practiced timely initiation of complementary feeding in this study. Besides, 6-8 months of infancy is the transition period where mothers/caretakers struggle to teach babies to take solid and semi-solid foods.

A statistically significant negative association was found between early postnatal depressive symptoms (within three days of birth) and overall IFP score in this study. So far only few studies have used IFP index in feeding practice studies and to the researchers' best knowledge there is no study which explores the longitudinal relationship between IFPs and maternal depressive symptoms using an IFP index. However, several previous observational studies reported that maternal postnatal depression is

associated with specific components of IFPs; though, the direction of association between breastfeeding and postpartum depression remains unclear [40]. Systematic reviews in 2019 and 2015concluded that depressed women breastfed their child for shorter duration than non-depressed women[23,41]. Other previous studies also reported a negative association between maternal depression and early initiation of breastfeeding [42], complementary feeding initiation [43] and infants' dietary diversity [44,45].

Infants born to women who experienced intimate partner violence were at greater risk of poor IFPs. This finding is consistent with previous studies [46–48] and has important implications, particularly in Ethiopia, where 34 percent of ever-married women experienced such violence [14]. There are many pathways that intimate partner violence can affect maternal health and behavior [49]. Through its biological pathway, intimate partner violence is a stressor to which the autonomic nervous system, the hypothalamic–pituitary–adrenal (HPA) axis, and the cardiovascular, metabolic, and immune systems respond and hence leads to depression [50–52]. As stated above, maternal depression leads to poor IFPs. Furthermore, intimate partner violence has negative outcome on poverty and household food security by affecting couples capacity to organize and manage resources available in order to assure food and nutrition security of the family.

Contrary to many of previous studies, we found that infants in moderately and severely food insecure households rather have better IFP scores. Several previous studies reported that household food insecurity was negatively associated with IFPs [53–55]. However, the direction of the association does not mean that all infants in food secure households received appropriate and adequate feeding. In Uganda, Pascal et al. found that 8 out of 10 infants in food secure households were not receiving the minimum dietary diversity required and reported that household food insecurity explains only 10 percent of the variance of dietary quality determinants [56]. Conversely, our finding agrees with the studies in Kenya and Tanzania [57,58]; both studies concluded that infants from food insecure households were less likely to receive cow milk before they reached 6 months. Particularly in Kenya, dairy producing households had a 12-fold increased risk for exclusive breastfeeding interruption by early animal milk introduction compared to those in households without cattle.

Another probable reason for the positive association between food insecurity and IFPs in this study could be ENGINE program vulnerable households focused IYCF interventions. ENGINE end-line impact assessment reported that the program achieved over 10 percentage point increase in infant and child feeding index (ICFI) in 50% of intervention Districts [59]. Studies showed that IYCF focused nutrition education for caregivers improved child dietary diversity and nutrition knowledge of caretakers even in

food insecure areas [60,61]. Moreover, as we indicated earlier, the IFP scores were relatively higher during the first 6 months than the second half of infants' age; during this period the IFP elements are more amenable to improve by IYCF focused social and behavior change communications; costing no or minimal resources for a rural mother.

In this study, about half of the women participating in the study reported that they feel they have good social support during pregnancy (43.8%) and immediately postpartum (56.2%). We found that maternal social support was positively associated with IFPs. In agreement with our findings, previous studies reported that maternal social support helps mothers to practice appropriate infant and young child feeding [62,63]. Similarly, our study revealed that infants whose mothers actively participated in social groups have a better IFP scores than those with poor participation. Previous studies reported that social participation is associated with mental and physical health benefits. Seeman and colleagues found that having three or more regular social contacts, as opposed to zero to two such contacts, is associated with lower allostatic load scores [64]. Lower allostatic load mean lower depression [65,66] and then better IFP scores. In Ethiopia social groups are main platforms to reach mothers with IYCF messages [67].

Gestational age at birth was positively associated with IFP scores. This implies that preterm infants were not receiving good IFPs compared to their full term counterparts. Consistent with our findings, previous studies reported that mothers of preterm infants initiated breastfeeding late and that pre-term infants are breastfed for a shorter duration [54–56]. Similarly, observational studies in Italy and the United Kingdom reported early introduction of solid foods with a majority of preterm infants receiving a solid food prior to 4 months of age [71,72].

A systematic review by Kajali and Vector revealed that restriction or interruption of complementary foods during illness is frequent because of children's anorexia, poor awareness by caregivers' about the feeding needs of sick children, traditional beliefs and behaviors, and/or suboptimal counseling and support by health workers [73]. However, we found that infants with higher morbidity episodes have higher IFP scores. We presumed that frequent episodes of illness increase mothers' frequency of contact with health care providers and hence repetitive IYCF counseling which improves mothers' IYCF awareness and practices. Abegaze and colleagues reported that in Ethiopia, mothers with prior experience of infant illness were more likely to seek health care for their sick children than their counterparts [74]. Moreover, as a sick infant loses appetite, mothers could frequently serve different

types of food to the infant that potentially increases diet diversity and/or frequency and increase the IFP scores.

Mothers with primary and above school qualification seemed to perform better with respect to IFPs than illiterate mothers. This finding is in agreement with previous studies in Ethiopia and elsewhere [13,42,44,45,75]. This may be explained by educated mothers having better understanding of IYCF itself and/or had exposure to IYCF awareness raising campaigns (through their ability to read leaflets, posters and banners) that have been conducted for several years by the Ministry of Health and development partners in Ethiopia.

One of the main strengths of this study is that it is based on community based longitudinal data with appropriate analytical techniques applied. The study had a large sample size, high response rate and low attrition. Data were collected on regular intervals on several important socio-demographic, nutritional and clinical risk factors that could be harvested for this analysis. In addition, we used 14 WHO recommended IYCF core and optional indicators to compute the IFP score[31]. One limitation of this study is that IFP data were based on mothers/caretakers reports and, thus, are subject to possible recall biases. Moreover, presence of depressive symptoms may cause mothers to have more negative views about things around them, including household food security, child health and feeding practices.

Conclusions

Infant feeding practices in Ethiopia are very poor; particularly, dietary diversity and consumption of iron rich foods are unacceptable low and prenatal and postnatal maternal depressive symptoms are quite common. About two third of the households are food insecure. Early postnatal depressive symptoms and intimate partner violence are negative predictors of IFPs. Whereas, maternal education, maternal social support, maternal social participation and gestational age at birth are positively associated with IFPs.

The implications of our findings for practice are to emphasize the need for prevention, early detection and treatment of early postpartum depression, intimate partner violence and strengthen household food security interventions so that mothers are healthy, food secured and practicing appropriate infant feeding as per WHO infant feeding recommendation. In this regard, we recommend the Ethiopian Ministry of Health to integrate postnatal maternal depression and intimate partner violence screening into the routine postnatal care service and Ministry of Agriculture together with other relevant

ministries, donors and implementers to strengthen household food security interventions. Moreover, we recommend all relevant stakeholders particularly Ministry of Women Affaires to promote maternal social support and social participation. Overall, we concluded that a multitude of factors are related to IFPs and need coordinated, multi-sectoral and multi-stakeholder interventions.

Declarations

Abbreviations

CI: Confidence Interval; HITS: Hurt, Insult, Threaten and Scream; IFP: Infant Feeding Practice; IPV: Intimate Partner Violence; IYCF: Infant and Young Child Feeding; MSS: Maternal Social support; OR: Odds Ratio; PHQ-9: Patient health questionnaire-9; USAID: United States Agency for International Development

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Authors' contributions

YK designed/implemented the study, analyzed the data and drafted the manuscript; SG & TB designed/implemented the study and critically reviewed the final version of the manuscript; VS, EK, & HKB assisted data analysis and write up and critically reviewed the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The data that support the findings of this study are available from Tufts and Jimma Universities but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Tufts and Jimma Universities.

Ethics approval and consent to participate

The study was conducted in accordance with the WHO's ethical and safety recommendations for research on domestic violence against women [76]. The main principals to justify this research were also fulfilled according to the World Medical Association Declaration of Helsinki [77]. During data collection, all measures were taken to ensure that women could get support if it was deemed necessary. Study participants who were screened positive for depressive symptoms or IPV were referred to a nearby health facility for possible social and medical support. Ethical clearance was obtained from Jimma University ethical review board. Informed written consent was obtained from all individual participants included in the study. All interviews were conducted in private and confidentiality was ensured for each study participants.

Consent for publication

Not applicable

Competing interests

We declare that we have no financial or non-financial competing interests.

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6

Chapter 6

General Discussion

Chapter 6: General Discussion

This thesis draws on theoretical background and a conceptual model of how selected psychosocial stressors (such as household food insecurity and intimate partner violence) and coping strategies (for example, maternal social support) are linked to psychological distress (maternal depression), which can influence mothers' and infants' nutritional status. The original contribution of this work is threefold. First, it adds to the existing literature on the links between psychosocial stressors, social support, and depression, by demonstrating the degree to which household food insecurity and intimate partner violence during pregnancy are associated with the risk of antenatal depressive symptoms, and assessing the role of maternal social support as a buffer in this dynamic. It also examines the longitudinal relationship of prenatal and postnatal depressive symptoms on infant feeding practices. Additionally, this work has contributed to the literature on maternal depression by validating one of the most commonly applied measurement tools, a patient health questionnaire (PHQ-9), in a new culture and language.

Below, the main findings of the current work are discussed in light of the results of related previous studies, followed by a discussion of the strengths and limitations of the study.

5.1. Patient Health Questionnaire (PHQ-9) Validation and Maternal Depressive Symptoms Prevalence

The first paper validated an Afaan Oromo version of the Patient Health Questionnaire (PHQ-9), one of the most commonly used depression measurement scales globally. Few validation studies have been conducted in sub-Saharan Africa for instruments used to detect depression in pregnant women and to the author's knowledge this is the first validation of an Afaan Oromo version of the PHQ-9 questionnaire among pregnant women in Ethiopia. PHQ-9 has been applied widely in depression screening elsewhere. However, self-report instruments are potentially vulnerable to distortion due to a variety of reasons including social desirability, response style, and cultural interpretation(1), and a thorough cultural adaptation including reliability and validity assessments are warranted before applying the instrument in a new culture and/or language (2).

The main finding of this validation study was that the PHQ-9 scale has acceptable reliability and validity as a screening instrument for depressive symptoms among Afaan Oromo-speaking pregnant women in Ethiopia. A cut-off value of PHQ-9 score of eight or above was recommended to detect depressive symptoms (**Chapter I**). This finding is consistent with a meta-analysis which reported that the PHQ-9 has acceptable diagnostic properties for detecting depression for cut-off scores between eight and eleven (3). However, a hospital-based Amharic version PHQ-9 validation study in Ethiopia

recommended a score of 10 or above as an optimal cut-off value to detect depression in the general population (4). In fact, the same cut-off score may not be appropriate in all settings and for different population groups in this context; choosing a specific cut-off score must consider several domains including characteristics of the study population and the study setting (3). In a hospital setting, for example, medical patients often over-report their somatic symptoms, e.g. fatigue and anorexia, which may have resulted from their physical illnesses and a higher cut-off value is expected.

This validated PHQ-9 scale was applied to measure the prevalence of maternal depressive symptoms and to test the hypotheses of the present study (**Chapter II** and **Chapter III**). This study indicated that a significant number of mothers reported depressive symptoms during pregnancy (10.8%) and postpartum (18.5%). However, prenatal depressive symptoms were relatively lower than previous reports in Ethiopia (33).The relatively lower prevalence of prenatal depressive symptoms in this study likely reflects the fact that this is a population-based study while the prior studies were primarily conducted in health facilities. Moreover, the difference may reflect variations in the depression screening instruments used. Okagbue and colleagues recently reviewed 26 research articles on antenatal depression and found that those 26 articles utilized a total of 16 different depression measurement tools with significant variation in prevalence of antenatal depression reported (5).

Similarly, Slomian and colleagues in their recent systematic review concluded that prevalence of maternal depression depends on the definition and/or the tool used to diagnose and also on the cut-off values used with the same diagnostic tool (13). They reviewed 122 articles and found that 15 different tools were utilized with a prevalence of postpartum depression varying from 2.7% in Pakistani mothers (14) to 68.8% in Australian mothers (15). That same review revealed that there were several disparities in cut-off values. For example, among the studies that used the Edinburgh Postpartum Depression Scale (EPDS), cut-off values ranging from 8 to 14 were used to screen for postnatal depression. Previous studies have shown prevalence of postpartum depressive symptoms in Ethiopia varied depending on the measurement tools applied. For example, recent studies which applied PHQ-9 reported postnatal depression prevalence of 12.2% to 22.4% (6–8) and those which applied EPDS reported a relatively higher prevalence ranging from 20.9% to 33.8% (9–12).

5.2. Psychosocial Stressors and Prenatal Depressive Symptoms

Paper II tested hypotheses derived from Lazarus and Folkman's stress and coping theory. This theory provides a basis for understanding the impacts of psychosocial stressors on the development of depression and the buffering effect of coping mechanisms. The hypotheses were that increased

environmental stressors, specifically intimate partner violence and household food insecurity during pregnancy, lead to higher prenatal depressive symptoms, and that strong perceived social support from friends, families and partners has a buffering effect. In addition, the second article tested another hypothesis that the risk of prenatal depressive symptoms is higher in women who suffer from prenatal anaemia. The present study findings supported these hypotheses as described below (see **Chapter IV**).

5.2.1. Household food insecurity and prenatal depressive symptoms

The present study showed that about two-thirds of the households in this study area experienced any type of food insecurity and more than half were either moderately or severely food insecure at baseline. This finding is consistent with recent epidemiological studies which reported household food insecurity in Ethiopia ranging from 54% to 72% (16–19). However, the prevalence of moderate or severe food insecurity in this study is relatively lower than the average prevalence in east African countries; according to the 2019 *Food Security and Nutrition in the World* report which reported that more than 64% of households in east Africa are moderately or severely food insecure (20).

Food insecurity is a powerful stressor which has potentially negative consequences on mental, social and physical well-being (21–23). Several previous researchers reported that household food insecurity has strong links with poor physical health (24–26) and mental disorders (27–33). This study supports a link between food insecurity and prenatal depressive symptoms, with pregnant women in food-insecure households showing greater than a tenfold increased risk of experiencing prenatal depressive symptoms compared to their food-secure counterparts. This finding is consistent with several other previous studies in Ethiopia and elsewhere (34–36).

Household food insecurity influences prenatal depression through a number of pathways. The experience of food insecurity itself is a stressor characterized by worry and anxiety about the household food supply as it creates uncertainty over the ability to maintain food supplies, or to acquire sufficient food in the future. Especially when the household suffers food insecurity repeatedly or for longer periods of time, it becomes a chronic stressor and can provoke a stress response and depression (37,38). Moreover, mothers in food insecure households may adopt negative coping strategies and be forced to acquire food for her family in socially unacceptable ways, which can expose the mother to feelings of alienation, powerlessness, shame, and guilt; these types of feelings are associated with depression (39–41). The association between food insecurity and depression has a vicious cycle, whereby depression can increase vulnerability to poverty and food insecurity, and food insecurity and

poverty can increase the risk of depression (42–44). Managing a food insecure household is extremely difficult and is in itself a stressor(45).

5.2.2. Anaemia and Depressive Symptoms during Pregnancy

Prenatal anaemia is a significant global public health problem affecting 38.2% of pregnant women worldwide (46). In the present study more than a quarter of pregnant women were diagnosed with anaemia. This finding is relatively lower than the national average in 2016, in which the Ethiopian Demographic and Health Survey (EDHS) demonstrated the prevalence of anemia in pregnant women to be29.1% (47). Conversely, this finding is higher than other recent studies in Ethiopia which reported a prenatal anaemia prevalence ranging from 7.9% in the north to 23.2% in the south and 11.6% in the capital city (48–50).

Several authors reported nutrition as one of the key modifiable factors in the development and pathogenesis of depression (51–60). In line with this evidence, the present study found that haemoglobin concentration level was lower in pregnant women with depressive symptoms than in pregnant women without depressive symptoms. In contrast, a placebo and high-iron diet-controlled supplementation trial among female participants in high income countries found no association between depression and anaemia(61). While the relationship and direction between depression and maternal anaemia remains unclear and in need of further investigation, researchers have developed several hypotheses about the mechanisms which may link anaemia to depression.

Recent evidence suggests that one possible factor linking diet and depression may be the gut microbiota via the gut-brain axis (62). The gut-brain axis is a bidirectional link between the central nervous system and the enteric nervous system of the body (63). Previous studies have shown that diet affects the composition of the gut microbiota (64,65), and gut microbiota influences the level of tryptophan (66,67). Tryptophan is a precursor of serotonin (68). Serotonin and its receptors in the brain have a role in the development of depression (69,70). Iron is a co-factor in synthesis of tyrosine and tryptophan. Tyrosine and tryptophan are precursors for the neurotransmitters dopamine, norepinephrine and serotonin (71). Correspondingly, the traditional monoamine hypothesis of depression speculates that low dopamine, norepinephrine, and serotonin concentrations may lead to depression (72) and the glutamate hypothesis of depression posits that dysregulation of the glutamatergic system results in depression (73). Studies show that iron deficiency is linked to glutamate dysregulation(74,75). Similarly, iron is a cofactor for the reaction leading to the production and secretion of glutamate (76). Thus, both monoamine and glutamate hypotheses suggest that iron deficiency anaemia can lead to depression.

5.2.3. Intimate Partner Violence (IPV) and Prenatal Depressive Symptoms

Intimate partner violence is quite common during pregnancy and postpartum which makes it of particular concern due to the consequences for the mother herself, the fetus, and later for the child(77,78). The present study found that the prevalence of IPV reported during both pregnancy and postpartum was less than ten percent (5.0% during pregnancy and 8.9% immediately after birth). Although this finding is within the global prevalence range reported in a recent meta-analysis by James and colleagues(79), it is much lower than the prevalence reported by previous studies both in Ethiopia (80) and other African countries (81). According to James and colleagues, depending on the definition, assessment tools and population, the global prevalence of IPV during pregnancy ranges from 4.8 to 63.4%.

The low prevalence of IPV identified in the current study may be due to the type of IPV measurement tool applied. We used a four-item HITS scale to screen for IPV. Three of the HITS items (insult, threat and scream) measure the emotional (psychological) aspects of intimate partner violence and one of the HITS items(hurt) measures physical violence. Clearly, this instrument lacks a sexual violence component which may diminish the IPV prevalence (82). Additionally, lower sensitivity compared to specificity is a common shortfall of short IPV screening instruments (82,83) and hence the current study may not capture all IPV-affected pregnant women due to the nature of the screening tool.

As discussed in Chapter IV, the present study found a statistically significant association between IPV and prenatal depressive symptoms. Consistent with this finding, a growing number of studies have demonstrated that IPV is associated with both prenatal (84,85) and postnatal depression (86–89). There are different pathways that link IPV with maternal depression. Fear and learned helplessness are the most common reasons for IPV to generate adverse mental health consequences including depression (90,91). Fear of stigmatization may cause IPV victims to experience feelings of shame and isolation and to avoid openly communicating this violence to others (91). This can result in a lack of support from friends and family; coping means, and rather leads to depression.

Furthermore, IPV victims may face economic and social crises (92)leading to poverty. Poverty is also one of the key aggravating factors for IPV, as poorer households have fewer resources to reduce stress(93). Poverty reduces household purchasing power and results in household food insecurity. Acute or chronic exposure to periods of food insecurity can influence mental and physical health outcomes (94).

5.3. Perceived Social Support and Prenatal Depressive Symptoms

The present study supports the hypothesis that strong perceived social support buffers the effects of depression by showing that pregnant women who reported poorer perceived social support were at higher risk of prenatal depressive symptoms than pregnant women with adequate perceived social support. Many previous authors reported a negative association between social support and depressive symptoms during pregnancy (95–100). For example, a recent meta-analysis in Ethiopia revealed that women who received no support from their spouses were three times more likely to suffer from prenatal depression than women who reported receiving adequate support (101).

The exact mechanisms underlying the buffering effect of social support on depression are unknown. However, previous works speculated that social support may moderate genetic and environmental vulnerabilities and confer resilience to stress, possibly via its effects on the hypothalamic-pituitary-adrenocortical (HPA) system, the noradrenergic system, and central oxytocin pathways (102,103). This evidence initially came from the pioneering work of Kaufman and colleagues which has shown that social support may confer resilience to stress by moderating genetic risks for depression in maltreated children (104). Another possible mechanism through which social support enhances resilience to stress is via the dampening of HPA activity. Animal and translational studies have revealed that social support reduces the release of stress-induced cortisol (102). Of note, high social support (actual support receipt; not perceived) may not always play a buffering role, but may actually be associated with increased distress (105,106). As Lepore and colleagues explained, high levels of social support may activate self-doubt and low self-esteem due to the perception that one is not capable to take care of herself (107).

As mentioned in the background, marital status can be used as a measure of social support; particularly the social support sub-type of social embeddedness, which refers to the connections that individuals have to significant others in their social environments. The present study showed that marital status and prenatal depressive symptoms are linked; unmarried pregnant women were more at risk of prenatal depressive symptoms than their married counterparts. Other studies in Ethiopia and elsewhere reported similar findings (108–110). Thus, the present study suggests that social embeddedness provides a protective role in prenatal depressive symptoms.

5.4. Infant Feeding Practices (IFP)

To the author's knowledge, this is the first study investigating the longitudinal relationship between IFPs and maternal depressive symptoms using an IFP index, a composite indicator which allows IYCF practices to be measured in their entirety. No previous studies were identified which applied an IFP computed index in the investigation of the relationship between IFPs and maternal depressive symptoms. Thus, studies examining the association between maternal depression or psychosocial stressors and specific components of IFPs such as initiation of breastfeeding, exclusive breastfeeding, initiation of complementary feeding, etc. were cited to discuss the present findings.

5.4.1. Infant Feeding Practices and Maternal Depressive Symptoms

The third paper tested the hypothesis that infants born from mothers with maternal depressive symptoms (prenatal and postnatal) are more likely to have poor infant feeding practice scores than their counterparts. The present findings supported this hypothesis by showing that immediate postnatal depressive symptoms were negatively associated with infant feeding practices. However, there was no association between prenatal depressive symptoms and infant feeding practices.

Consistent with this finding, several previous observational studies reported that maternal postnatal depression is associated with specific components of IFPs. Systematic reviews in 2019 and 2015concluded that depressed women exclusively breastfeed their children for a shorter duration than non-depressed women(111,112). Other previous studies also reported a negative association between maternal postnatal depression and early initiation of breastfeeding (113), complementary feeding initiation (114) and infants' dietary diversity (115,116). Conversely, a recent community-based study in Ghana reported that maternal depression was not associated with complementary feeding indicators in younger children of 6-23 months (117). The possible reason for this difference could be due to the small sample size in the Ghana study; only 200 mother child dyads were involved. As the author explained, it could be also due to cultural differences in child care practices in the two countries. In Ethiopia, the majority of men are not involved in child feeding activities, whereas in most rural Ghanaian families all adults in the household contribute to child care practices (117).

Extant literature also reported that prenatal depressive symptoms are associated with IFPs such as early breastfeeding initiation (118), exclusive breastfeeding (119), breastfeeding duration (120), and timely initiation of complementary feeding. However, in the present study there was no statistically significant

association between prenatal depressive symptoms and total IFP score but with specific IFP components particularly with early breastfeeding initiation and minimum meal frequency.

5.4.2. Infant Feeding Practices and Intimate Partner Violence

In the present study, infants born to women who suffered from IPV were at greater risk of poor IFPs. This finding is consistent with similar previous studies (121–123) and has important implications, particularly in Ethiopia, where 34 percent of ever-married women experienced such violence (124). For example, a recent systematic review conducted using published articles from 51low-income and middle-income countries concluded that mothers exposed to any form of IPV were less likely to initiate breastfeeding early and neither breastfeed exclusively in the first 6 months (125).

There are many pathways through which intimate partner violence can affect IFPs(126). First, IPV is a stressor which leads to depression (127–129). As stated in section 5.4.1 above, maternal depression leads to poor IFPs (130). IPV can also indirectly affect IFPs by influencing mothers' exposure to antenatal care services (125) and hence access to nutrition related counseling. Studies have suggested that in resource limited settings quality prenatal and delivery care services significantly increase early initiation and duration of exclusive breastfeeding in the first 6 months of life (131). According to WHO, women who suffer from IPV face social problems, lack of family support, restricted access to services, strained relationships with health care providers and employers, and isolation from social networks (132). As a result, affected mothers initiate prenatal care later or receive inadequate care or no antenatal care at all (133,134). Another pathway could be that mothers with low self-esteem or lack of confidence as a consequence of IPV (135) are also less likely to exercise adequate IFPs (136).

5.4.3. Infant Feeding Practices and Household Food Insecurity

Contrary to expectations, the results of the present study did not support the hypothesis that infants in food insecure households have poor IFP scores. This hypothesis was based on studies suggesting that food insecurity is a stressor that can have an effect on care giving practices which in turn can lead to poorer infant feeding practices (137–139). However, the present study suggested that infants in moderately and severely food insecure households had better IFP scores. Several previous studies reported that household food insecurity was negatively associated with individual components of IFPs (140–142). In fact, the direction of the association does not mean that all infants in food secure households received appropriate and adequate feeding. In Uganda for example, Pascal et al. found that 8 out of 10 infants in food secure households were not receiving the minimum dietary diversity required

and reported that household food insecurity explains only 10 percent of the variance of dietary quality determinants (143). However, our finding agrees with previous studies in Kenya, Tanzania and Bangladesh (144–146); these studies concluded that infants from food insecure households were less likely to receive cow's milk before they reached 6 months. Particularly in Kenya, dairy producing households had a 12-fold increased risk for interruption of exclusive breastfeeding by early animal milk introduction compared to those in households without cattle. In Bangladesh, Saha et al. demonstrated that for infants3-6 months of age better household food security was associated with poorer IFPs, but this was reversed later during 6-9 and 9-12 months of age.

The concept of compensatory maternal feeding practices might explain the above unexpected association between household food insecurity and IFPs(147). As previous studies reported, food insecure mothers are more likely to sacrifice their food quality to preserve children's usual levels of food intake (148–150) and mothers have shown to exhibit pressuring feeding styles to their babies leading even to obesity (147). Another possible influencing factor in this particular study could be the ENGINE program's package of IYCF interventions. ENGINE's impact assessment reported that the program achieved more than a10 percentage point increase in the infant and child feeding index (ICFI) in 50% of intervention Districts (151). Studies showed that IYCF-focused nutrition education for caregivers improved child dietary diversity and nutrition knowledge of caretakers even in food insecure areas (152,153). Moreover, as we indicated earlier, the IFP scores were relatively higher during the first 6 months than in the second half of the infancy period; IFP indicators relevant during this period are more amenable to change by IYCF-focused social and behavior change communication interventions with minimal to no costs required for a rural mother.

5.4.4. Infant Feeding Practices, Perceived Social Support and Active Social Participation

Paper III also investigated the influence of perceived social support and active social participation on IFPs. The findings showed that both perceived maternal social support and active social participation were positively associated with IFPs. This means that mothers with strong social support and who are actively involved in social groups also are more likely to exercise appropriate IFPs. Congruent with these findings, previous studies reported that maternal social support (154,155) and active social participation (156) help mothers to practice appropriate infant and young child feeding. For example, Seeman and colleagues found that having three or more regular social contacts, as opposed to zero to two such contacts, was associated with lower allostatic load scores. Lower allostatic load leads to lower levels of

depression (157,158) and hence better IFP scores. In Ethiopia social groups such as women development armies are the main platforms to reach mothers with IYCF messages (159).

There are many pathways that link more social participation to improved IFPs. Participating in community-based organizations enables women to have better economic independence and access to information, which leads to more autonomous and informed household decision-making (160) and also facilitates increased use of formal health services (161,162). It follows that a woman with appropriate knowledge, autonomous household decision making capacity, and the necessary means may be more likely to execute recommended IFPs. However, participation in local organizations may not always contribute to better infant feeding practices, and may even have counterproductive effect. For example, participation in religious or other organizations with norms restricting maternal autonomy or reinforcing counter-productive beliefs on childcare and feeding practices may instead impact IFPs negatively (163,164).

Strengths and Limitations

In chapters III-V some strengths and limitations of the individual papers were indicated. The discussion below brings together those mentioned in each chapter and presents them in a single location.

The study has several strengths mainly derived from its design and sample size. This study used a prospective longitudinal birth cohort design. Thus, the data were collected prospectively, allowing for evaluation of the direction of the proposed relationship, particularly between prenatal and postnatal depressive symptoms and IFPs. As a longitudinal design with seven follow-up periods, attrition was expected. Thus, appropriate steps were taken to minimize attrition including the calculation of a large sample size, community sensitization, and an empathetic approach to data collection. The larger sample size also allowed us to assess the associations of interest with narrow confidence intervals. Moreover, before the start of data collection, adequate community sensitization was conducted and health extension workers were involved in identifying pregnant women in their communities and provided an introduction of the purpose of the study to the participants. During the regular review meetings and refresher trainings, enumerators and field supervisors were encouraged to interact with participants empathetically so as to build the confidence of participating women and improve the response rate.

Another strength of the study was the application of a locally validated depressive symptoms measurement tool. The PHQ-9 was validated on pregnant women in a district near the study sites before the start of the main data collection. The tool was found to be valid and reliable (**Chapter 3**);

hence improving the reliability of the study findings. Furthermore, particularly for Paper II and Paper III, a number of potential covariates identified from previous literature were included in the multivariate models. In addition, appropriate and robust analytical methods were applied. For example, for Paper III the linear multilevel mixed effects model was suitable for analyzing the longitudinal data, which can minimize the accumulation of Type I error from repeated measures [51].

However, the study findings should be interpreted with caution given the following study limitations. Participants of the PHQ-9 validation study may not represent all of the Afaan Oromo speaking population in Ethiopia, because Afaan Oromo language has several dialects and the translation and cognitive debriefing were based on the Wellega and Tulama dialects. Hence, further retranslation and cultural adaptation is warranted if this instrument is to be used in other Oromo dialects. Additionally, PHQ-9 is a self-reported depressive symptoms screening tool. But as all of the assessments were conducted through interviews, technical validity or comparison with self-administered formats-of the PHQ-9 was not assessed due to the high illiteracy rate of the participants. Moreover, PHQ-9 is not a clinical assessment for diagnosing actual depression, but rather indicates that sufficient depressive symptoms are present in order to make a depression diagnosis likely. Hence, the present study measured prenatal and postnatal depressive symptoms and not depression per se.

The HITS tool applied to measure IPV in this study lacks a sexual violence component. HITS is a brief four item IPV screening tool mainly assessing the psychological aspects of IPV with one item dedicated for physical violence. Moreover, being a brief scale it might miss cases and share common shortfalls of many brief screening instruments; lower sensitivity compared to specificity (82,83). Finally, the IFP data were based on mothers/caretakers reports and therefore are subject to possible recall biases. Moreover, the presence of depressive symptoms may cause mothers to have more negative views about things around them, including household food security, child health and feeding practices.

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7

Chapter 7

Conclusion and Implication

Chapter 7: Conclusion and Implication

7.1. Conclusion

The findings of the present study add to the existing literature on the links between psychosocial stressors, coping mechanisms and depression by demonstrating the positive association of two selected salient maternal psychosocial stressors: namely, household food insecurity and intimate partner violence during pregnancy with antenatal depressive symptoms. It also demonstrates the buffering role maternal perceived social support can play against prenatal depressive symptoms. Moreover, the findings demonstrate the longitudinal relationship of prenatal and postnatal depressive symptoms with infant feeding practices; early postnatal depressive symptoms were negatively associated with IFPs. Perceived maternal social support and active social participation positively predicted IFPs. Additionally, this work has contributed to the depression literature by validating one of the most commonly applied depression measurement tools, the PHQ-9, in a new culture and language. The PHQ-9 proved to be a reliable and valid instrument that may be used to screen depressive symptoms among Afaan Oromo speaking pregnant women in Ethiopia.

7.2. Implication

It is hoped that this section will inform policy makers and practitioners in Ethiopia and elsewhere about practices that may prevent prenatal and postnatal depression and improve infant feeding practices and nutrition outcomes. It will also inform researchers and provide guidance for areas where contributions would address knowledge gaps. Several implications can be drawn from this study; however, the most pertinent ones are presented below, divided into implications for practice and research.

7.2.1. Implications for Practice

A. Promoting Routine Maternal Depression and IPV Screening and Linkage to Services

Women and infants may particularly benefit from routine screening for depression and IPV. The current study and review of previous literature demonstrated that depression is quite common during pregnancy and postpartum in Ethiopia. Similarly, this study presented the importance of maternal depressive symptoms and IPV during pregnancy and postpartum by showing a possible link between IPV and prenatal depressive symptoms (Chapter IV) and a negative association of infant feeding practices with both postnatal depressive symptoms and IPV (Chapter V). Nonetheless, in Ethiopia, neither depressive

symptoms nor IPV are routinely screened during pregnancy and postpartum. Depression during pregnancy and postpartum often goes unrecognized by health care providers as changes in sleep, appetite and fatigue may be attributed to normal pregnancy and postpartum changes (1). Furthermore, women often are reluctant to report changes related to depression; for example, Whitton and colleagues reported that over 80% of women diagnosed with postpartum depression had not reported symptoms to health care providers (2).

Similarly, IPV victims often experience feelings of shame and isolation and do not communicate openly to others that violence has occurred to them by their spouses (3). This results in lack of support from others and can lead to more depression. In Ethiopia, only 45% of IPV victim women sought formal help and the victims mentioned different reasons for not seeking help, including violence being perceived as "normal," fear of further attack, fear of losing children, and in an attempt to avoid shaming the family(4). Randomized controlled trials in the developed world have shown that routine IPV screening increases the identification of affected women, but have not shown a reduction in IPV recurrence nor any notable benefit for women's health (5–7). However, because of the dual vulnerability of pregnancy, WHO recommends routine IPV screening for pregnant women during ANC visits (8).

Consequently, during pregnancy and postpartum women may particularly benefit from early integrated screening for depression and IPV. The periods of pregnancy and postpartum generally provide a unique opportunity for screening due to the regular medical contact mothers have during this time. In Ethiopia, the routine antenatal and postnatal care services at health posts, health centers and hospitals may be a good opportunity to deliver the proposed integrated routine screening services during pregnancy and postpartum periods. However, screening without subsequent appropriate intervention may be counter-productive as women may find repeated screening difficult and potentially decrease their utilization of other health services. Therefore, the screening activities should be supported by appropriate service provision and linkages.

The present study also demonstrated that prenatal anaemia and depressive symptoms may be linked. Similarly, as reported in the recent Ethiopian Demographic and Health Survey, a good number of women either received no ANC services at all, delayed initiation of these services, or never screened for anaemia during their pregnancy [213]. Therefore, another screening related practical implication of the current study may exist by strengthening the current prenatal routine screening for anaemia together with the distribution and follow up of iron supplementation, and the promotion of an iron-rich diet.

B. Promote Single, Nationally Validated Tool for Routine Maternal Depression Screening

As described in the general background and discussion sections, prenatal and postnatal depression studies in Ethiopia report a wide range of depression prevalence depending on measurement tools applied. Many of those studies applied the tools without prior validation. Given the limited resources allocated for mental health in Ethiopia and other resource limited countries, routine screening requires tools that are brief, free, easily accessible and which have established reliability and validity metrics (9). The patient health questionnaire (PHQ-9) can serve as a routine maternal depressive symptom screening tool in Ethiopia. The present validation of PHQ-9 fulfills requirements to serve as a routine depression screening tool. The scale is brief, easy to understand, simple to score, freely available, and has good psychometric properties comparable to other long measures of depression (10,11). The 9 items are developed based on DSM-IV criteria and hence can serve both to diagnose probable depression and to grade the severity of depressive symptoms (12). The development of simple software that scores and provides interpretations, enhancing tool utility, would reduce the burden on service providers associated with additional screening and increase standardization of interpretation(9).

C. Design and Implement Effective Depression Preventive Interventions

Ethiopia has a very limited number of mental health professionals to treat depression, and treatment alone did not reduce the disease burden to the level expected. Studies in Australia and Europe revealed that current depression treatment options reduce the disease burden only by 34% even when all patients receive an evidence-based treatment (13,14). Thus, well-designed depression prevention interventions may be the most effective strategy. There is evidence showing preventive interventions effectively reduce depression incidence (15) and that these preventive interventions are cost-effective and cost saving as well (16).

D. Strengthen Household Food Security Interventions

Policies aimed at reducing household food insecurity are likely to have a significant public health impact on the prevention of prenatal depression. The present study demonstrated that household food insecurity is a strong stressor which can lead women to depression. This finding highlights the importance of household food security interventions beyond addressing consumption and nutrition gaps, but also in preventing prenatal depression. A study by Noonan et al. demonstrated that supplemental nutrition assistance programs in Canada can reduce depression among poor mothers (17). Previous interventional studies suggested both cash transfers and food subsidies were able to reduce household

food insecurity (18). Hence, strengthening Ethiopia's flagship productive safety net program (PSNP), especially its soft conditionality program, could have benefits for maternal depression as well.

Soft conditionality in the PSNP program links pregnant and lactating mothers/care takers in the PSNP program to essential Maternal and Child Health services as a co-responsibility (or soft condition) of receiving the monthly PSNP cash transfer. In this case, the reverse referral should also be promoted; health care providers who screen a mother with depressive symptoms could probe to determine if the mother also faces household food insecurity and link this case to the PSNP program. This and similar promising interventions to alleviate household food insecurity need to be promoted in this context. As discussed in **Chapter 4**, men in food secure households are less violent than those in food insecure households and hence improving household food insecurity may also prevent IPV and hence depressive symptoms.

On the other hand, contrary to expected, the current study has shown that mothers in food insecure households may implement better infant feeding practices than those in food secure households. Based on this finding, advocating for policies to invest in and promote household food security solely as a means to improve infant feeding practices may have minimal impact without additional social and behavior change components.

E. Develop and Implement IPV Prevention Interventions

Women and infants during both pregnancy and postpartum may benefit from effective IPV interventions. The present study demonstrated that IPV predicts prenatal depressive symptoms and also negatively affects IFPs (see **Chapter IV & Chapter V**).The background section also highlighted the relationship between IPV and depression as bidirectional and cyclical; IPV is associated with depressive symptoms, which in turn may increase risk for future IPV victimization (19–21). Interventional studies also support this bidirectional link by demonstrating that reductions in depressive symptoms in survivors of IPV through psychological intervention resulted in reduction of risk for future victimization (22). Another interventional study by Hansen and colleagues indicated that specifically developed IPV intervention programs significantly reduced the women's psychological symptoms and also had a significant positive effect on the women's levels of perceived social support(23). Moreover, a recent systematic review of IPV interventions concluded that women's empowerment-based advocacy and cognitively focused clinical interventions have positive outcomes on the vast sequelae of IPV (24). Effective IPV prevention requires designing and implementing targeted social and behavioral change communication (SBCC) to change the attitudes, beliefs and values of both male and women on gender related issues.

F. Strengthen Formal and Informal Maternal Social Support

The present study demonstrated the buffering role of perceived social support on prenatal depressive symptoms (**Chapter IV**) and its direct role in improving IFPs (**Chapter V**). Thus, government and non-governmental organizations working on maternal and infant health and nutrition in Ethiopia are encouraged to include targeted advocacy and promotion for social support and active social participation interventions in their programs. According to the Canadian Institute for Health Information, women who have opportunities to regularly interact and talk with others were significantly more likely to report a reduction in distress than women who did not feel they had those supports(25).

While formal social support services rendered by social workers and counselors should be improved and strengthened, other models of social support provisions should be explored. Sensitizing and encouraging existing informal support groups such as spouse, families, friends, religious leaders and other community leaders could potentially be even more effective than the formal channels.

G. Encourage Active Social Participation during Pregnancy and Postpartum

Similarly, the current study demonstrated that mothers who actively participate in social institutions or groups such as farmers' groups, women's groups, religious groups, youth groups, health related or well-being groups, and/or Kebele committees (administration, saving, and credit, and other groups) better practiced appropriate infant feeding compared to mothers who did not participate. This finding highlights the need for strengthening these local institutions or groups and promoting and encouraging women to participate in them. In Ethiopia a number of ministries, especially health, agriculture, women affairs and labor and social affairs ministries, utilize these social groups as their official channels to reach households and deliver services. Therefore, encouraging mothers to participate in these social groups will benefit them both in access to the ministries' services and in the improvement of IFPs.

Women's development teams (WDT) and the 1 to 5 arrangement at the village level in Ethiopia are good examples. The 1 to 5 arrangement is a voluntary group of five households in the same neighborhood, and WDT is a voluntary group of 30–36 households in the same neighborhood, formed from five to six 1 to 5 arrangements. WDTs help the health extension worker with a number of tasks, including transmitting health messages between HEWs and households, and vice-versa. A mother who actively participates in the WDT and/or 1 to 5 arrangement is well informed about the 16 health extension packages including appropriate infant feeding practices (26). Similarly, a woman who actively participates in the women's group is aware of gender equality and how to prevent and handle violence against women. There are a variety of other important social groups such as community care coalitions

which if properly strengthened, promoted and utilized can serve as a buffer to maternal depression and also improve health and nutrition outcomes for the mother and her children.

H. Establish and Strengthen Multidisciplinary Cooperation and Multisectoral Coordination for Mental Health

The current study has shown that both maternal depression and infant feeding practices are multifactorial public health problems. Moreover, the causes and consequences of household food insecurity and IPV are also multifactorial. Thus their intervention needs multidisciplinary cooperation and multisectoral coordination. The health sector alone cannot resolve everything. For example, the prevention and management of IPV incidence requires the cooperation of many sectors such as health, justice, women affairs, etc. The same is true for household food insecurity requiring the cooperation of agriculture, social affairs, finance, health and other relevant ministries.

7.2.2. Implications for Future Research

As discussed in the previous chapters, the findings of the present work generally supported the hypotheses and were in line with the conceptual framework developed for this particular study. However, the current study did not explore everything supported by the framework. Therefore it is suggested that future studies are warranted to explore the following issues guided by the current study's conceptual model so as to fully understand the effects of psychosocial and other stressors during pregnancy and postpartum.

A. One of the limitations of the present study was that depression was measured using a self-reported questionnaire which identifies the presence of depressive symptoms rather than depression per se. Future research may benefit from combining biological measurements of stress such as salivary cortisol and alpha-amylase with the questionnaire (bio-psychosocial model). Concurrence of the results of both biological measures and the questionnaire would provide more likely confirmation of the presence of depression than the questionnaire alone.

B. Intimate partner violence and household food insecurity are not the only stressors experienced during pregnancy. Pregnancy specific stressors like parenting concerns, bodily changes, anxiety about labor and delivery, concerns about the infant's health etc. are unique to pregnant women and are equally important to investigate its consequences on maternal and infant health and nutrition. Future research could benefit from the inclusion of pregnancy specific stressors in assessing psychosocial stressors' influence on maternal and off-spring health and nutrition. Related to this, it

is imperative to develop and validate pregnant women's daily hassles measurement tool; no such tool is available for Ethiopia yet.

C. As indicated in the theoretical framework, psychosocial stressors result in psychological distress (depression and/or anxiety). Studies on the effects of anxiety during pregnancy (pregnancy-related anxiety and general anxiety) on birth outcomes and maternal and infant health and nutrition are very limited in Africa including in Ethiopia. Hence, future studies on this topic would help to fully understand the effect of psychosocial stressors during pregnancy and postpartum on the mother and her offspring.

D. To date, globally, very limited interventional studies have been done to explore the sources of social support that are most effective in preventing maternal depression. An interventional study is required to assess which type of social support (perceived versus actual) and from which sources would be most effective in buffering prenatal and postnatal depression. Similarly, research is needed to identify the best mechanism of enhancing social support at individual, group and community levels.

E. The current study and previous literature also suggested that household food security is not a guarantee for appropriate infant feeding practices. Therefore, investigating factors influencing IFPs in food secure and insecure households and why mothers/caregivers in food secure households did not practice appropriate infant feeding will have invaluable input to design targeted IFP interventions.

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Publications

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Awards

1. Won the German Society of Tropical Paediatrics and International Child Health (GTP) 2017 Helmut Wolf award.

Hohenheim, June 2, 2020 Yitbarek Kidane Woldetensay

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Annex 3

Declaration in lieu of an oath on independent work

according to Sec. 18(3) sentence 5 of the University of Hohenheim's Doctoral Regulations for the Faculties of Agricultural Sciences, Natural Sciences, and Business, Economics and Social Sciences

1. The dissertation submitted on the topic

Maternal Psychosocial Stressors, Depression and Its Implications on Maternal and Infant Nutrition: A Longitudinal Birth Cohort Study in South West Ethiopia

is work done independently by me.

2. I only used the sources and aids listed and did not make use of any impermissible assistance from third parties. In particular, I marked all content taken word-for-word or paraphrased from other works.

3. I did not use the assistance of a commercial doctoral placement or advising agency.

4. I am aware of the importance of the declaration in lieu of oath and the criminal consequences of false or incomplete declarations in lieu of oath.

I confirm that the declaration above is correct. I declare in lieu of oath that I have declared only the truth to the best of my knowledge and have not omitted anything.

Hohenheim, 02/06/2020

Place, Date

Signature