

Theory-based nutrition education intervention through male involvement improves the dietary diversity practice and nutritional status of pregnant women in rural Illu Aba Bor Zone, Southwest Ethiopia: A quasi-experimental study

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Abstract

Maternal undernutrition is a major public health problem that disproportionately affects women in low-income countries. Despite attempts to address maternal nutritional needs, Ethiopia still has a high rate of undernutrition. Hence, this study aimed to evaluate the effect of theory-based nutrition education through male engagement on dietary practice and the nutritional status of pregnant women. A pretest–posttest quasi-experimental study was conducted among 403 pregnant women selected from 22 kebeles of Illu Aba Bor zone, Southwest Ethiopia from July to December 2019. A pre-tested, structured interviewer-administered questionnaire was used for data collection. A qualitative 24-h dietary recall was used to assess dietary diversity, and the Mid-Upper Arm Circumference was used to assess nutritional status. The intervention effect was evaluated using difference-in-difference, generalized estimating equation, and linear mixed-effects models. The mean dietary diversity score differed significantly between the couple group, women-alone and the control group ($p < 0.001$). According to the multivariable generalized estimating equations model, couples were 3.9 times; adjusted odds ratio (AOR) = 3.91, 95% CI: (2.57, 6.88) and women alone were 2.8 times; AOR = 2.86, 95% CI: (2.17, 3.88) more likely to consume a diverse diet than the control group. The nutritional status of the women in the couple group improved significantly by the end of the intervention ($p < 0.001$). This study showed that involving males in nutrition education intervention was effective in improving the dietary diversity practice and nutritional status of pregnant women. The findings imply the need for targeting couples in designing nutrition education interventions.

KEYWORDS

dietary diversity, nutrition education, nutritional status, pregnant women

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1 | BACKGROUND

The nutritional status of a woman during the prenatal period has significant long-term effects for the mother, the growing fetus and the newborn (Darnton-Hill & Mkpuru, 2015; Marangoni et al., 2016). Undernutrition during this critical period is closely linked to functional consequences such as a higher risk of adverse birth outcomes, infant mortality and the development of chronic diseases later in life (Khoushabi & Saraswathi, 2010; Saaka, 2012). Maternal undernutrition is a known risk factor for IUGR-associated low birth weight and neonatal deaths (Desyibelew & Dadi, 2019; Woldeamanuel et al., 2019). It causes an estimated 800,000 newborn deaths per year around the world (Yakoob & Bhutta, 2011). Low- and middle-income nations in Africa and Asia are disproportionately affected by maternal and infant undernutrition, as well as unfavourable pregnancy outcomes (Ahmed et al., 2012; WHO, 2014).

The monotonous, plant-based diets that are poor sources of bioavailable minerals and vitamins and little intake of animal source foods, vegetables and fruits that are critical for a healthy pregnancy are the main causes of widespread undernutrition and its associated effects in sub-Saharan Africa (Imamura et al., 2015). These have been recognized as significant contributors to the worldwide burden of maternal undernutrition (Saaka, 2012). Moreover, the relatively high cost of nutrient-dense foods like animal source foods, fruits and vegetables jeopardize efforts to improve dietary quality (Acham et al., 2012; Bain et al., 2013). Even when enough food is accessible, most women do not take adequate nutrients during pregnancy due to poor knowledge of what constitutes an adequate diet (Ahmed et al., 2012).

Recognizing the importance of nutrition, Ethiopia's government updated its national nutrition programme in 2016 to address the double burden of undernutrition among pregnant and lactating mothers (FMOH, 2014). The Health sector development plan IV has integrated nutrition into the Health Extension Program to improve the nutritional status of mothers and children through Community Based Nutrition Program, Health Facility Nutrition Services and Micronutrient Interventions and Essential Nutrition Actions/Integrated Infant and Young Child Feeding Counseling Services. Despite these efforts, local studies suggest that undernutrition among pregnant women in Ethiopia is prevalent, ranging from 9.2% to 31.8% (Dadi & Demelash, 2019; Desalegn Kuche et al., 2015; Diddana, 2019; Mariyam & Dibaba, 2018; Nigatu et al., 2018), and the pregnant women's low dietary diversity practices vary from 24.2% to 74.6% (Delil et al., 2018; Desta et al., 2019; Jemal & Awol, 2019; Nana & Zema, 2018).

Indeed, studies have shown that nutrition education during pregnancy is linked to a healthier pregnancy (Streuling & Beyerlein, 2010). There is evidence that health promotion programmes that combine behaviour change strategies, home visits and participatory campaigns can help mothers maintain their health throughout their reproductive years, according to Barry et al. (2014). Schiffman et al. (2010) also emphasize the relevance of family–community care in harmonizing with a community's social and cultural milieu. This promotes the adoption of healthy lifestyle choices both in the home

Key messages

- Promotion of optimal dietary diversity is a global priority to improve maternal nutrition and healthier pregnancy.
- Interventions that provide the appropriate information about dietary diversity are needed to improve pregnant women's feeding behaviours, thereby enhancing nutritional status and birth outcomes.
- Theory-guided nutrition education delivered through male involvement improved dietary diversity practice and nutritional status of pregnant women.
- Behaviour change nutrition education interventions that engaged not only pregnant women but also their husbands is an effective approach in improving dietary practice and nutritional status of pregnant women.

and in the community. A study in Iran found that a nutrition education programme among pregnant women was beneficial, with a substantial increase in nutritional knowledge from 3% to 31%, regardless of maternal age or educational level (Fallah et al., 2013). In line with this, a recent study in rural India found that community-based efforts, specifically, gatherings of mothers intended to promote healthy behaviours, are effective and can be extrapolated to a larger population (Acharya et al., 2015).

Individual characteristics and the surrounding environment can be identified using theory and models, which can help in behaviour change as a result of educational interventions. Consequently, behaviour modification theories and models can be highly helpful in the design and evaluation of comprehensive educational programmes (Hamayeli et al., 2009).

The Theory of Planned Behaviour (TPB) is one of the behaviour change theories that is widely used in nutrition education. According to this theory, an individual's intention can be predicted by three determinants, namely attitude towards the behaviour, beliefs about the motivation to comply with other expectations (subjective norms) and beliefs about the perceived level of control over factors that can either facilitate or hinder behaviour performance (perceived behavioural control) (Ajzen, 1991) (Figure 1).

Recent evidence also draws attention to the need to consider the wide spectrum of social, cultural and economic factors, as well as the significance of engaging members of the family to optimize the health of women of reproductive age in the design of health interventions (Mwangome et al., 2010). Although evaluations are sparse, and many existing evaluations are of short term or pilot projects, the benefits of interventions to improve male participation in household health outcomes have been documented. Male involvement interventions in maternal health (Yargawa & Leonardi-bee, 2015) and reproductive health, particularly in the prevention of mother-to-child transmission of HIV (Kalembo et al., 2013) have demonstrated notable positive effects on areas like post-natal consultation attendance and PMTCT regimen uptake and adherence. Compared with maternal health and

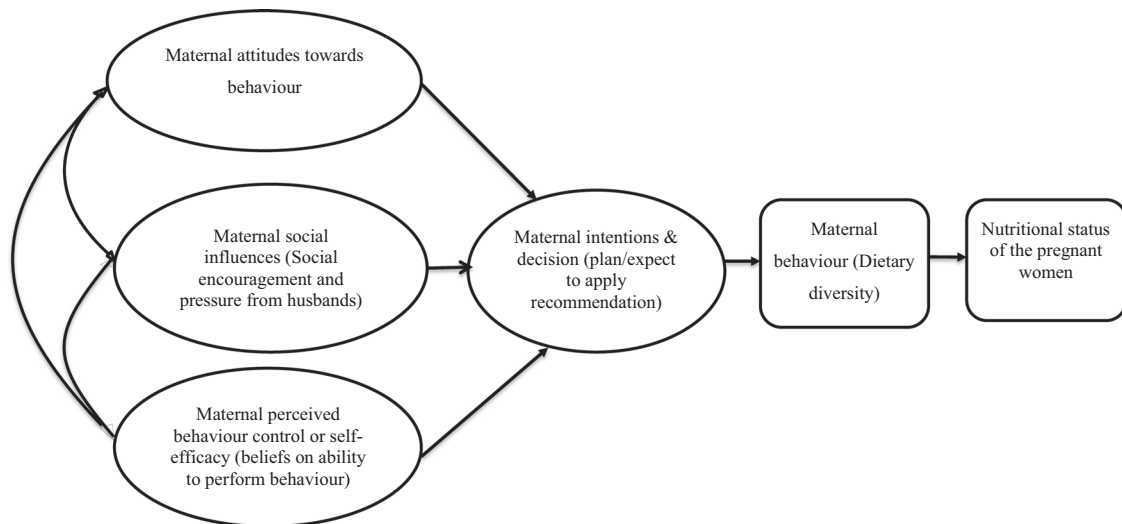


FIGURE 1 Theoretical model for this study (Adapted from Ajzen, 1991). TPB constructs. TPB, Theory of Planned Behaviour

PMTCT, the effects of male engagement on nutrition-or child-health-related behaviours and outcomes (including in community-focused interventions), and the extent to which men are involved in these domains, have been less explored (Dumbaugh et al., 2014). Including husbands in social behaviour-change programmes for nutrition is particularly important in societies, where women's decision-making autonomy is particularly low, and households are predominantly male-headed (Osamor & Grady, 2016).

Evidence on the effect of a nutrition education intervention on the dietary diversity practice and nutritional status of pregnant women is scarce. Hence, the objective of this study was to assess the effect of nutrition education using the TPB in improving the dietary diversity practice and nutritional status of pregnant women in Illu Aba Bor Zone, Southwest Ethiopia. The results of this study would be helpful for the planning and implementation of context-specific nutrition interventions to prevent undernutrition during pregnancy. Further, it could be useful for policymakers at the regional and national levels to design strategies for the prevention of undernutrition during pregnancy and improve prenatal nutrition services.

2 | METHODS

2.1 | Study setting and period

Pregnant women in rural communities of Illu Aba Bor Zone, Southwest Ethiopia, participated in this community-based pretest–posttest nonequivalent control quasi-experimental study. The Zone is one of the 21 zones of Oromia National Regional state located at a distance of 600 km from Addis Ababa in the southwest direction. The Zone is divided into 14 districts, with 23 urban and 263 rural kebeles (the lowest administrative unit) and a total population of 934,783, of which 467,553 are males and 465,792 are females, and lies between 34° 52' 12" E to 41° 34' E longitudes and 7° 27' 40" N to 9° 02' 10" N

latitude. Agriculture is the predominant means of livelihood in the Zone. The intervention started in July 2019 among pregnant women in the first and early second trimesters of pregnancy (Figure 2).

2.2 | Study population and sampling technique

Pregnant women in their first and early second trimesters (up to 16 weeks of gestation) were included in the study. We enrolled all consenting pregnant women in their first 16 weeks of pregnancy because the intervention was to be implemented before the delivery period. Furthermore, pregnant women who had lived in the study area for at least 6 months were included to maintain homogeneity in access to nutrition-related information and health services. Pregnant women with the diagnosis of serious health problems requiring a special diet and nutritional needs were excluded. G*Power 3.0.10 (Faul et al., 2007) software was used to calculate the sample size considering a 95% confidence level, group of three, a power of 88% for *F* test, 5% margin of error and effect size of 0.2. Further considering 10% allowance for nonresponse and design effect of 2, the final sample size was 373. However, the sample size calculated for the baseline survey as part of this project described elsewhere (Tsegaye et al., 2020) was larger. Hence, larger sample size was considered.

2.3 | Allocation to the study arm and blinding

In the first stage, four districts were selected. In the second stage, these districts were stratified into three according to the geographic direction and proximity to each other. The districts were assigned to either the control group or one of the two intervention groups. Then, kebeles were selected at random from the districts that were

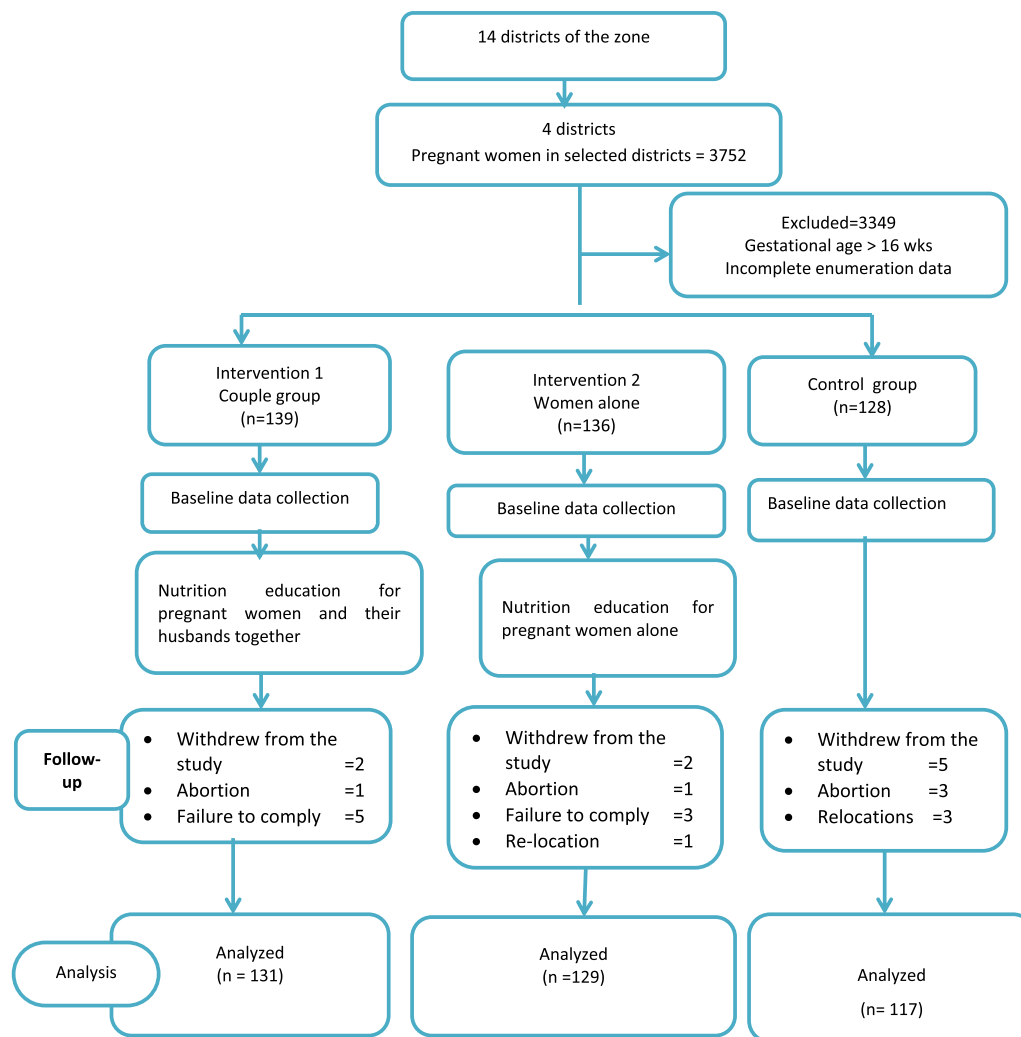


FIGURE 2 Flowchart of the progress of the study participants through the phases of the intervention

selected. Pregnant women were enumerated using house-to-house visits in all of the selected kebeles, and the pregnant women who fulfilled the inclusion criteria were included in the study (Figure 2). Due to the nature of the intervention, the participants and intervention implementers were not blinded to the allocation.

2.4 | Theoretical framework of the study—TPB

In this study, TPB was used to identify the psychosocial processes (behaviour mediators) that lead to intervention outcomes, both for evaluation and to explain changes in dietary behaviour. The study's goal was not to test the theoretical model; rather, it was to provide guidance on the types of variables and processes that may be important in shaping maternal health behaviours and should be addressed in the intervention. The intervention aimed to improve personal and normative nutrition actions (Armitage & Conner, 2001) towards diversified diet sustenance as a result of positive nutrition attitudes and behaviour control.

2.5 | Intervention

Participants were assigned to one of the three study arms: Couple group: husband and wife received health education together; women alone: pregnant women received health education alone and the control group: received no education. It was implemented once a month for three sessions over 3 months. Each education session lasted for 45–60 min. The language of communication during the intervention delivery was the local language (Afan Oromo).

Training and educational resources were developed based on the WHO recommendation of community Infant and Young Child Feeding Counselling Package (UNICEF, 2013) and Federal Ministry of Health training manual for trainers (Federal Democratic Republic of Ethiopia, 2013). Furthermore, the formative assessment at the beginning of the project guided the development of the tool. The intervention package included (1) a training guide for the nutrition educators, (2) a manual for the nutrition educators, (3) leaflets with the core messages for the pregnant women's families and (4) counselling cards. The intervention protocol was pilot tested in a

similar setting outside the study area for 2 weeks and modification was made based on the result of the pilot testing.

Two public health professionals with a qualification of Bachelor of Science and two qualified in Master of Public Health were recruited as educators and supervisors of the intervention process, respectively. Educators were selected based on their previous experience in giving education services. A 5-day intensive training was given to the educators and supervisors using the training manual.

2.5.1 | Nutrition education to the intervention groups

Nutrition education was given to the couples (pregnant women and their husbands together) and to the pregnant women alone. The two intervention groups were placed in groups and received nutrition education every month for 3 consecutive months. Direct (teacher-directed) and interactive (discussion, sharing) teaching approaches guided the strategy for conducting the nutrition education sessions. The core contents were: (1) describing nutrients in foods and their role in promoting good health, (2) the consequences of inadequate nutrient intake, as well as vulnerability to the severity of the consequences of inadequate nutrient intakes and (3) key recommendations for including a variety of foods to increase intake of essential nutrients. In addition, adherence to the iron/folic acid supplement and iodized salt was also emphasized in the nutrition education. Then, the participants were encouraged to make implementation goals.

2.5.2 | Monthly home visits and counselling of the pregnant women

One health extension worker (HEW) was assigned to each intervention village to provide counselling and support to mothers. The HEWs were trained before going to the field. They made home visits once per month for 3 months of the intervention period to counsel the pregnant women to adopt recommended practices following the nutrition education. The counsellors were provided with counselling cards. Achievements and unresolved difficulties during the visits were discussed during supervisory or monitoring visits.

All pregnant women seeking ANC received nutrition education from the care providers, following a national standard protocol. Pregnant women from both the control and the intervention groups had access to this service.

2.6 | Intervention fidelity

The fidelity of the intervention was evaluated using best practice recommendations developed by the National Institutes of Health (NIH) Behavioral Change Consortium (Bellg et al., 2004). The recommendations cover (i) study design: establishing procedures to monitor and reduce the potential for contamination between active

treatments or treatment and control, as well as to measure dose and intensity; (ii) provider training: standardization of training to ensure that all providers are trained in the same manner; (iii) treatment delivery: behavioural checklists to ensure that providers adhered to the treatment protocol and (iv) treatment receipt: through supervisory visits to the study area and performance evaluation meetings with the nutrition educators and HEWs.

2.7 | Data collection instruments and procedures

A pre-tested structured interviewer-administered questionnaire adapted from different literature (Ajzen, 2019; Coates & Swindale, 2007; CSA & ICF, 2016; Kennedy et al., 2010) was used to collect the data. The questionnaire was prepared in English and translated to the local language (Afan Oromo) and then translated back to English by language experts to keep its consistency. Training was given to the data collectors and supervisors on data collection and anthropometric procedures. A pretest was done on 5% of the sample to assess the applicability of the instrument and was verified accordingly.

There were three phases to the data collection process. In the first phase, a list of pregnant women who met the criteria (sampling frame) was compiled by conducting a home-to-home enumeration (census) in each of the selected kebeles. During the registration of the pregnant women, the district, kebele, 'Got' (further subdivisions of kebeles), 'Gare' (the smallest community structure combined to form Got), and name of household head were considered for the subsequent follow-up visits. The first date of the last menstrual period and a pregnancy test were used to screen the pregnant women. Second, baseline data on TPB components, food taboos, sociodemographic and economic characteristics, 24-h recall on dietary diversity, household food security status, nutritional status (MUAC), obstetric history, health service-related factors and household assets to compute wealth index were collected. In the third phase, end-line data on TPB components, 24 h recalls, household food security status and other variables were collected after the intervention process.

Women's attitudes, subjective norm, perceived behavioural control and intention towards diverse diet consumption were all assessed as outcome-related psychological data. A 5-point response Likert scale was used to assess the attitude, subjective norm, perceived behavioural control and behavioural intention. A colour-coded scale was used using different colours with red indicating strongly disagree, yellow indicating disagree, light blue indicating neutral, light green indicating agree and green indicating strongly agree. Women's attitudes towards eating a variety of foods were examined using 15-item questions (e.g., attitudes towards increasing food consumption during pregnancy, attitudes towards eating one more meal daily, and attitudes towards taking iron/folic acid every day). The perceived behavioural control was examined using three items. Intention to consume a diversified diet was also assessed using five questions. Additionally, subjective norms towards dietary diversity practice were assessed using three questions.

Individual women's dietary diversity (WDD) was assessed using a 24-h qualitative dietary recall. WDD is a score based on nine food groups that are recommended as a qualitative measure of micro-nutrient adequacy of a diet (Kennedy & Ballard, 2011). Participants were asked to recall everything they ate and drank in the previous 24 h, both inside and outside the home. In addition, they were asked to recall any snacks they had eaten in between main meals. Consumption of a food item during the reference period was assigned a '1', while nonconsumption was assigned a '0'. The foods were then divided into nine food groups: (1) starchy staples; (2) dark green leafy vegetables; (3) vitamin A-rich fruits and vegetables; (4) other fruits and vegetables; (5) organ meat; (6) meat and fish; (7) eggs; (8) beans, nuts and seeds and (9) milk and milk-related products. The definition of the sum of food groups consumed during the reference period was used to calculate a dietary diversity score. The dietary diversity score was converted into tertiles, with the highest tertile defining 'high' dietary diversity score and the two lower tertiles defining 'low' dietary diversity score (Belachew et al., 2013).

As there is minimal change in mid-upper arm-circumference (MUAC) during pregnancy, it is considered to be a better indicator of nutritional status of pregnant women than body mass index (BMI) (Tang et al., 2016) because pregnancy-related weight gain affects the reliability of using BMI to assess pregnant women's nutritional status. MUAC measurement was taken on the left arm of participants to the nearest 0.1 cm using flexible and nonstretchable measuring tapes following the standard procedures (Tang et al., 2016).

The Household Food Insecurity Access Scale (HFIAS) that has been validated and used in other developing countries was used to assess household food security status (Coates & Swindale, 2007). The tool has nine questions enquiring about the household's previous month's experience of three domains of food insecurity: feeling the uncertainty of food supply, insufficient quality of food, and insufficient food intake and/or its physical consequences. An HFIAS score ranging from 0 to 27 was calculated for each participant and then households were categorized into different levels of food security (food-secure and mildly, moderately, or severely food-insecure) according to the recommendation (Coates & Swindale, 2007).

The Ethiopian Demographic and Health Survey's wealth constructs were used to determine household wealth status which included type and number of livestock (cow/oxen, chickens, goat, sheep and horses); ownership of improved sanitation (latrine) facility; type of cooking fuel; housing condition (main construction of house wall, floor and roof); the number of sleeping rooms; ownership of chair; and ownership of a working mobile phone (CSA & ICF, 2016). The wealth index was constructed using principal component analysis. The assumptions of the principal component analysis of overall sampling adequacy (Kaiser–Meyer–Olkin measurement of sampling adequacy > 0.5), Bartlett's Test of Sphericity ($p \leq 0.05$), having commonality > 0.5 and not having the complex structure correlation of ≥ 0.40 were checked. The latent factor reflecting the wealth index generated using principal components analysis was then classified into wealth quintiles.

The affective attitudes were assessed as women's self-evaluation at baseline and at study endpoint that is, before and after the intervention using the same questions. To assess behaviour controllability, the women were asked if they experienced challenges with sustaining a diverse diet. Subjective norm was assessed as individual versus family involvement in sustaining a diverse diet by asking the woman to evaluate the influence of self-initiative over family support on the sustenance of the diverse diet.

2.8 | Data quality control

The field supervisors provided onsite support for data collectors daily. All completed questionnaires were collected by their respective supervisors and checked overnight. Morning sessions were arranged to provide feedback on issues of concern identified from fieldwork on the next day. Doubtful interviews and anthropometric measurements were repeated by the supervisors. The logbook was used for monitoring the data collection procedures. The intensive training and supportive supervision were important aspects of quality assurance efforts.

2.9 | Data processing and analysis

Data were entered into Epidata version 3.5.1 and exported to SPSS version 23 for analysis. The study population was described using summary statistics of mean and percentages based on the study outcomes, sociodemographic characteristics and other factors. The Pearson correlation analysis was used to investigate the relationship between the dietary diversity score, nutritional status of pregnant women and the TPB constructs. Analysis of variance (ANOVA) was used to compare means between the control and intervention groups. A post hoc test (Tukey HSD test) was employed to establish the level of significance of values between and within groups when ANOVA was statistically significant. Statistical significance was declared at a p value of less than 0.05.

Difference-in-differences (DID) was used to estimate the average treatment effect on the treated by comparing the difference across time in the differences between outcome means in the control and treatment groups. This technique was used to control for unobservable time and group characteristics that confound the effect of the treatment on the outcome.

The effect of the intervention on dietary diversity was assessed using the generalized estimating equation (GEE) with a binary logit function. First, we performed correlation on all structures, and the Quasi-Information Criteria was the same for all correlation structures; therefore, we used an interchangeable correlation structure. The model was run to account for the clustered data and observational correlation within subjects. While fitting the model to account for the effects of various confounding variables, the unstructured covariance matrix was taken into consideration. Sociodemographic and

socioeconomic characteristics, household food security status, time, intervention, time and intervention interaction were analysed. The effect of the intervention was assessed using time and the intervention interaction. The odds ratio was calculated along with a 95% confidence interval (CI). Statistical significance was determined at a p value of less than 0.05.

A linear mixed-effects model was used to estimate the effect of the intervention on changes in the nutritional status of pregnant women over time. Before fitting the model, the normality assumption of the outcome variable (MUAC) was assessed by using the Shapiro-Wilk's test and the test showed that the assumption was satisfied ($p > 0.05$). We used the Akaike information criterion (AIC) to assist in selecting the appropriate statistical model. We chose the model that demonstrated the minimum AIC. Variables with $p < 0.2$ in the bivariate linear mixed regression model were selected as candidate variables for the multivariable linear mixed model analysis. The intervention's effectiveness was assessed by examining the interaction between time and the intervention.

3 | RESULTS

3.1 | Sociodemographic characteristics of pregnant women

The flow of the study participants through the intervention process is depicted in Figure 2. At the baseline, there was no significant difference in all sociodemographic characteristics between the intervention and control groups ($p > 0.05$) (Table 1).

3.2 | Mean score of the TPB constructs and correlation with the pregnant women's dietary practices and nutritional status

Change in the postintervention mean score of the TPB constructs is shown in Table 2. The mean attitude score in all three groups was similar at the start, but it increased significantly in the couple groups and the women-alone group when compared with the control group ($F = 129.792$, $p < 0.001$). Similarly, there was no significant baseline difference in subjective norm between the three groups, but it increased significantly among the couple and women-alone groups compared with the control group ($F = 56.188$, $p < 0.001$). The baseline perceived behavioural control was similar, but it significantly increased at the end ($F = 37.675$, $p < 0.001$). The behavioural skill was also comparable with the baseline. However, it significantly increased among the couple and women-alone groups at the end line ($F = 138.301$, $p < 0.001$) (Table 2).

All the TPB constructs had a significant positive correlation with the dietary diversity practice and nutritional status of the pregnant women ($p < 0.05$) (Table 3).

3.3 | Effect of nutrition education on dietary diversity practice

The findings of this study show that the mean dietary diversity score among the three groups was comparable at the baseline ($F = 2.644$, $p = 0.072$). However, the end line data show significant differences in mean dietary diversity scores between the couple group, women-alone, and the control group ($F = 17.476$, $p < 0.001$). The Turkey post hoc test shows a statistically significant difference in the mean DDS between the couple group and the women-alone group (6.8 vs. 6.2) (DID = 0.4 ± 0.15) ($p = 0.02$), the couple group and the control group (6.8 vs. 5.9) (DID = 0.80 ± 0.21) ($p < 0.001$), and the women-alone group and the control group (6.2 vs. 5.9) (DID = 0.41 ± 0.16) ($p = 0.029$) after nutrition education intervention (Table 4).

After controlling for possible confounding variables, the couple groups were 3.9 times; AOR = 3.91, 95% CI: (2.57, 6.88) and the women-alone group were 2.8 times; AOR = 2.86, 95% CI: (2.17, 3.88) more likely to consume a diversified diet than the control group in the multivariable GEE (Table 5).

3.4 | Effect of the nutrition education on nutritional status

This study indicated that there was no statistically significant difference in the three groups' mean MUAC at the baseline (22.87 vs. 22.72 vs. 22.78 cm) ($p = 0.816$). The end line data, however, revealed a significant difference in mean MUAC score between the couple and the control group (24.41 vs. 23.29 cm) ($p < 0.001$). Similarly, there was a significant difference in mean MUAC score between the women-alone and the control groups (23.73 vs. 23.29 cm, $p < 0.05$). The net mean difference (DID \pm SE) between the couple and the control groups was 1.03 ± 0.21 cm, while the difference between the women-alone and the control groups was 0.52 ± 0.20 cm. The differences were statistically significant ($p < 0.05$) (Table 4).

Variability of the average MUAC across individuals was statistically significant ($p < 0.001$). The intraindividual correlation coefficient was 0.681. After controlling for sociodemographic factors such as maternal age, maternal education, maternal occupation, wealth status, family size and dietary diversity score, women in the couple group showed significant improvement in nutritional status at the end of the intervention ($\beta = 0.923$, $p < 0.001$). Similarly, the women-alone group showed improvement in nutritional status after the intervention ($\beta = 0.458$, $p < 0.05$) (Table 6).

4 | DISCUSSION

This study aimed at determining the effect of theory-based nutrition education intervention through male involvement on the dietary diversity practice and nutritional status of pregnant women.

TABLE 1 Baseline sociodemographic and economic characteristics of the study participants in Ilu Aba Bor Zone, Southwest Ethiopia, June 2019

Characteristics	Category	Couples (n = 139), n (%)	Women alone (n = 136), n (%)	Control (n = 128), n (%)	p
Age of the mother in years	≤24	73 (52.5)	83 (61.0)	70 (54.7)	0.499
	25–34	62 (44.6)	47 (34.6)	52 (40.6)	
	≥35	4 (2.9)	6 (4.4)	6 (4.7)	
Marital status	Married	139 (34.5)	136 (33.7)	128 (31.8)	1.000
Religion	Orthodox	30 (21.6)	33 (38.8)	22 (25.9)	0.626
	Muslim	83 (59.7)	76 (28.9)	83 (34.3)	
	Protestant	26 (18.7)	27 (35.5)	23 (25.0)	
Ethnicity	Oromo	117 (84.2)	122 (89.7)	115 (32.5)	0.317
	Amhara	19 (13.7)	10 (7.4)	12 (29.3)	
	Others	3 (2.1)	4 (2.9)	1 (12.5)	
Educational status of the mother	No formal education	41 (29.5)	31 (22.8)	35 (27.3)	0.149
	Primary education	69 (49.6)	70 (51.5)	75 (58.6)	
	Secondary and above	29 (20.9)	35 (25.7)	18 (14.1)	
Educational status of the husband	No formal education	28 (20.1)	20 (14.7)	29 (22.7)	0.216
	Primary	85 (61.2)	77 (56.6)	70 (54.7)	
	Secondary and above	26 (18.7)	39 (28.7)	29 (22.7)	
Occupational status of the mother	Employee	6 (4.3)	6 (4.4)	5 (3.9)	0.481
	Merchant	9 (6.5)	16 (11.8)	7 (5.5)	
	Housewife	118 (84.9)	108 (79.4)	113 (88.3)	
	Daily labourer	6 (4.3)	6 (4.4)	3 (2.3)	
Occupational status of husband	Employee	19 (13.7)	29 (21.3)	11 (8.6)	0.115
	Merchant	12 (8.6)	12 (8.8)	11 (8.6)	
	Farmer	100 (71.9)	84 (61.8)	98 (76.6)	
	Daily labourer	8 (5.8)	11 (8.1)	8 (6.2)	
Family size	<5	109 (78.4)	120 (88.2)	108 (84.4)	0.086
	≥5	30 (21.6)	16 (11.8)	20 (15.6)	
Wealth quintile	Lowest	24 (17.3)	29 (21.3)	22 (17.2)	0.135
	Second	43 (30.9)	25 (18.4)	22 (17.2)	
	Middle	19 (13.7)	29 (21.3)	20 (15.6)	
	Fourth	26 (18.7)	34 (25.0)	29 (22.7)	
	Highest	27 (19.4)	19 (14.0)	35 (27.3)	
Household food insecurity	Food secure	70 (50.4)	76 (55.9)	66 (51.6)	0.630
	Food insecure	69 (49.6)	60 (44.1)	62 (48.4)	

Note: Others include Tigray, Gurage.

The study participants' sociodemographic characteristics and nutritional status were comparable at the baseline.

When compared with the baseline score and control group, the intervention groups' scores on the TPB components improved significantly. This finding is consistent with the study findings from

Khansar that reported the overall score of the TPB changed over time and a significant difference was observed between the intervention and control groups (Khayeri et al., 2019). A study among middle school children in Qoam city also showed a significant difference between the mean scores of attitudes, perceived behavioural control,

TABLE 2 Mean score of the TPB construct before and after the intervention among the study participants, Ilu Aba Bor Zone, Southwest Ethiopia, 2019/2020

TPB constructs	Study period	TPB constructs score			F test	Mean difference		
		Couple	Women alone	Control		Couple vs. control	Couple vs. women alone	Women alone vs. control
Attitude	Baseline	43.06 ± 4.06	43.38 ± 3.94	43.00 ± 4.17	0.347	10.21***	7.35***	2.86***
	End line	55.72 ± 6.21	48.61 ± 3.67	45.50 ± 5.61	129.792***			
Subjective norm	Baseline	9.58 ± 2.29	9.01 ± 2.86	8.96 ± 2.68	2.190	2.65**	0.91***	1.74***
	End line	12.05 ± 1.81	11.13 ± 2.14	9.40 ± 1.92	56.188***			
Perceived behaviour control	Baseline	7.06 ± 2.14	7.03 ± 2.21	7.09 ± 2.25	0.187	4.74***	0.94**	3.79***
	End line	11.91 ± 2.08	10.97 ± 2.29	7.17 ± 2.56	37.675***			
Behavioural Intention	Baseline	12.79 ± 3.86	11.95 ± 4.15	12.94 ± 4.39	2.245	4.46***	2.55***	1.91**
	End line	17.67 ± 4.36	15.11 ± 4.04	13.21 ± 3.37	138.301***			

Abbreviation: TPB, Theory of Planned Behaviour.

** $p < 0.01$.

*** $p < 0.001$.

TABLE 3 Correlation of the TPB constructs with the DDS and MUAC of the pregnant women in Ilu Aba Bor Zone, Southwest Ethiopia, 2019/2020

	Intervention	Attitude	Subjective norm	Perceived behavioural control	Behavioural intention	WDDS	MUAC
Intervention	—						
Attitude	0.614***	—					
Subjective norm	0.113*	0.299***	—				
Perceived behavioural control	0.278***	0.326***	0.604***	—			
Behavioural intention	0.266***	0.143**	0.158**	0.368***	—		
WDDS	0.293***	0.191***	0.197***	0.179***	0.195***	—	
MUAC	0.292***	0.298***	0.137**	0.112*	0.135**	0.047	—

Abbreviations: MUAC, mid-upper arm circumference; WDDS, women's dietary diversity score.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

intention and practice of eating breakfast in the experimental and control groups (Gharlipour et al., 2015).

All of the TPB showed a substantial positive correlation with constructs dietary diversity score and nutritional status of pregnant women. The improved changes in the behaviour mediators and their association with high DDS and nutritional status could indicate the effectiveness of the intervention in encouraging positive attitudes, beliefs and expectations of good nutrition during pregnancy. This finding is in line with the finding of a study in West Gojam, Ethiopia, which revealed that all the health belief models and TPB dimensions showed a substantial positive correlation with the nutritional status of pregnant women (Demilew et al., 2020c). This might be due to the reason that those with nutrition education attained more favourable attitudes and behavioural control.

Previous studies evidenced the positive significant effect of theory-based nutrition counselling to promote healthy nutritional behaviour before and during pregnancy (Diddana et al., 2018; Demilew et al., 2020c; Khoramabadi et al., 2016; Peyman & Abdollahi, 2017). Similarly, the findings of this study show significant differences in mean dietary diversity scores between the groups after intervention. Pregnant women who received theory-based nutrition education had higher dietary diversity scores compared with the control group. Similar findings were reported from a study in Malawi and Ethiopia in which the intervention groups had higher DDS (Demilew et al., 2020a; Ziyenda Katenga-Kaunda et al., 2020). This implies that theory-based nutrition education promotes healthy dietary behaviours.

The study revealed that pregnant women who received education together with their husbands had higher dietary

TABLE 4 Differences in mean DDS and MUAC measurement by the group over the study period in Illu Aba Bor Zone, Southwest Ethiopia, 2019/2020

Variables	Study period	Intervention groups			F	Difference-in-difference, mean \pm SE (95% CI)		
		Couple	Women alone	Control		Couple vs. control	Women alone vs. control	Couple vs. women alone
Mean (\pm SD) DDS	Baseline	4.9 \pm 1.00	4.7 \pm 1.1	4.8 \pm 1.2	2.678	0.85 \pm 0.19 (0.48, 1.22)***	0.44 \pm 0.21 (0.04, 0.84)*	0.41 \pm 0.20 (0.02, 0.80)*
	End line	6.8 \pm 1.03	6.2 \pm 1.5	5.9 \pm 1.1	17.48***			
	Difference (EL - BL)	1.91 \pm 1.5	1.50 \pm 1.8	1.06 \pm 1.6				
Mean (\pm SD) MUAC	Baseline	22.87 \pm 1.6	22.72 \pm 1.5	22.78 \pm 1.7	0.023	1.03 \pm 0.27 (0.49, 1.56)***	0.50 \pm 0.29 (-0.07, 0.1.07)**	0.53 \pm 0.27 (-0.01, 1.07)**
	End line	24.41 \pm 1.5	23.73 \pm 1.8	23.29 \pm 1.75	13.05***			
	Difference (EL - BL)	1.54 \pm 2.4	1.01 \pm 2.4	0.51 \pm 2.3				

Abbreviations: BL, baseline; CI, confidence interval; DDS, dietary diversity score; EL, end line; MUAC, mid-upper arm circumference; SE, standard deviation; SD, standard error.

* $p < 0.05$.

** $p < 0.01$

*** $p < 0.001$.

diversity scores compared with the women-alone and control groups. This could probably be due to increased communication between the couples about healthy dietary practices during or after the nutrition education sessions that might have led to a greater understanding and/or retention of the information given. A similar finding was reported by a study on the impact of including husbands in antenatal health education services on maternal health practices in urban Nepal in which women who received an education with husbands were more likely to attend a postpartum visit than women who received education alone (Mullany et al., 2007). The finding is again similar to the findings of several studies in sub-Saharan Africa where male partner involvement was associated with a higher likelihood of women implementing PMTCT interventions (Kalembo et al., 2013; Tweheyo et al., 2010). A similar positive impact of the father's involvement on EBF was found in a quasi-experimental study carried out in Vietnam (Bich et al., 2019). Another study in India also reported a similar finding in which behaviour change intervention through women's self-help groups improved maternal and newborn health practices (Hazra et al., 2020). The finding implies the need for involving husbands in nutrition education intervention during pregnancy.

The study further revealed a significant improvement in the nutritional status of pregnant women after the intervention. The nutritional status of the intervention groups significantly improved when compared with the control group. The improvement was highly significant among the couple group compared with the women-alone and the control groups. This could be attributed to a change in the pregnant women's attitude and behavioural control, which improved the women's intention of eating a balanced diet, contributing to an increase in the pregnant women's MUAC. This finding is consistent with other studies that reported the positive effect of nutrition education intervention in improving the nutritional status of pregnant women (Demilew et al., 2020b, 2020c; Diddana et al., 2018). There was also a slight increase in the end line mean MUAC among the control group, which could be attributed to the change in MUAC with gestational age (López et al., 2011).

After controlling for sociodemographic factors such as the mother's age, maternal education, maternal occupation, family size and wealth status, pregnant women in the couple group exhibited a substantial improvement in nutritional status at the end of the study. A positive effect of a nutrition education intervention on improving the nutritional status of pregnant women was observed in similar studies conducted in Ethiopia and Tokyo (Demilew et al., 2020c; Haruna et al., 2017). The strengths of this study are the use of theory-based nutrition education, the inclusion of husbands of pregnant women in the nutrition education intervention, the follow-up from early pregnancy to delivery and the use of intervention strategies. However, the following limitations were acknowledged. Except for the MUAC measurement, all of the responses were based on the women's self-report, memory and truthfulness in answering the questions.

TABLE 5 Generalized estimating equation showing the effect of intervention on dietary diversity practice of the pregnant women in Illu Aba Bor Zone, Southwest Ethiopia, 2019/2020

Parameter	Beta coefficient	SE	95% CI	p	AOR	95% CI
Intercept	0.693	0.1961	0.309, 1.078	<0.001	2.00	1.36, 2.94
Couple group (Baseline DDS)	0.055	0.1427	-0.224, 0.335	0.698	1.06	0.799, 1.39
Women alone (Baseline DDS)	-0.268	0.1478	-0.557, 0.022	0.070	0.765	0.57, 1.02
Time	1.068	0.1474	0.779, 1.357	<0.001	2.91	2.18, 3.89
Couple group × time	0.838	0.1965	0.453, 1.223	<0.001	3.91	2.57, 6.88
Women alone × time	0.622	0.2139	0.202	0.001	2.86	2.17, 3.88

Note: The model was adjusted for maternal age, maternal education, maternal occupation, family size, wealth status, household food security status and baseline DDS. Group × time, intervention and time interaction. Maximum std. error = 0.214.

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; DDS, dietary diversity score; SE, standard error.

TABLE 6 Linear mixed-effects model predicting MUAC of pregnant women in Illu Aba Bor, Zone, Southwest Ethiopia, 2019/2020

Fixed effect	Model 1		Model 2		Model 3	
	Estimate (SE)	95% CI	Estimate (SE)	95% CI	Estimate (SE)	95% CI
Variables						
Intercept	23.35 (0.06)	23.22, 23.47	22.03 (0.12)	23.04, 23.48	22.304 (0.584)	21.165, 23.442
Couple group (Baseline MUAC)			-0.835 (0.285)	-1.395, -0.275	-0.795 (0.281)	-1.392, -0.277
Women alone (Baseline MUAC)			-0.473 (0.285)	-1.032, 0.087	-0.448 (0.280)	-1.029, 0.084
Intervention effect						
Couple group			0.975 (0.202)	0.624, 1.419	0.926 (0.205)	0.639, 1.443
Women-alone group			0.469 (0.202)	0.073, 0.865	0.458 (0.203)	0.156, 0.953
Age						
Maternal educational (Primary)					0.249 (0.147)	-0.303, 0.254
Maternal education (Secondary)					0.403 (0.178)	-0.038, 0.536
Maternal occupation (Merchant)					-0.454 (0.339)	-1.114, 0.206
Maternal occupation (farmer)					-0.267 (0.279)	-0.809, 0.276
Maternal occupation (Daily labourer)					-0.677 (0.396)	-1.448, 0.095
Family size (<5)					0.327 (0.187)	-0.042, 0.695
Wealth status						
Lowest					-0.631 (0.199)	-1.020, -0.242
Second					-0.411 (0.172)	-0.747, -0.075
Middle					-0.504 (0.192)	-0.880, -0.127
Fourth					-0.067 (0.182)	-0.424, 0.289
DDS (low)					-0.246 (0.131)	-0.502, 0.010
Random effect						
Level two variance	2.9072 (0.150)		2.8535 (0.148)		2.4396 (0.128)	
AIC	2925.692		2819.828		2812.488	
ICC	0.681		0.652		0.412	

Note: Model 1. Intercept-only model; Model 2. Slope-only model; Model 3. Intercept with slope.

Abbreviations: AIC, Akaike information criteria; CI, confidence interval; DDS, dietary diversity score; ICC, intraclass correlation; MUAC, mid-upper arm circumference; SE, standard error.

5 | CONCLUSIONS

This study revealed that theory-based nutrition education intervention through male involvement improves dietary diversity practice and nutritional status of pregnant women. Following the nutrition education intervention augmented by home-based counselling, the mean dietary diversity and nutritional status of pregnant women in intervention groups improved significantly compared with the control groups. The difference was, however, more pronounced in the couple group. Hence, this replicable behaviour change education intervention, with a focus on male involvement, can be scaled up and sustained with minimal investments through existing health systems and community structures.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ETHICS STATEMENT

The study was conducted following the Declaration of Helsinki on medical research involving Human Subjects (World Health Organization, 2001). The Institutional Review Board (IRB) of Jimma University Institute of Health provided ethical clearance after reviewing the protocol. The local authorities were informed about the research through an official letter from the university to obtain their permission. The respondents were given complete and accurate information about the study and their right to participate, including the ability to withdraw participation at any time. Following the dissemination of information, each study participant signed a written (fingerprint for those who were unable to read and write) consent form. Confidentiality was maintained throughout the study. The control group received a counselling card and a key message given after the end of the study.

AUTHOR CONTRIBUTIONS

Dereje Tsegaye came up with the study's topic and discussed it with Dessalegn Tamiru and Tefera Belachew. The study was designed by Dereje Tsegaye, Dessalegn Tamiru and Tefera Belachew, who also participated in and supervised the project and made major contributions to its implementation. Dereje Tsegaye wrote the manuscript, is in charge of the content, and then submitted the work for publication. The paper has been read and approved by all authors.

DATA AVAILABILITY STATEMENT

The related data will be made available upon request of the corresponding author.

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SUPPORTING INFORMATION

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