Knowledge and Practice of Dietary Diversity among Pregnant Women: Evaluation of a Large Scale Social and Behaviour Change Program in Bangladesh

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Abstract

The objective of this study was to evaluate the effectiveness of a U.S. Agency for International Development (USAID) supported large-scale social and behaviour change (SBC) intervention, SHIKHA Project, in improving dietary diversity among pregnant women. Cross-sectional survey was conducted in rural southwest Bangladesh and 509, 515, and 1,275 randomly selected pregnant women were interviewed at baseline, midline, and end-line; 514 and 1016 pregnant women from non-intervention areas were also included. SBC intervention was provided to pregnant women at both individual and group levels by trained community health workers during the antenatal and postnatal period. Dietary diversity scores (DDS) and knowledge scores were calculated by summing the number of food groups (from nine defined food groups) consumed by women during 24 hours and from unprompted responses on how many food groups pregnant women should eat. The mean knowledge score for dietary diversity was 5.04 at baseline and significantly increased by 1.68 units (95% CI: 1.51, 1.85) at the end-line. The mean DDS at baseline was 4.28 and significantly increased by 0.45 units (95% CI: 0.34, 0.57) at the end-line. The SBC intervention was effective in improving the dietary diversity of pregnant women, which may help to meet their additional nutritional requirements and improve pregnancy outcomes.

Keywords: Dietary diversity, Pregnant women, Maternal undernutrition, Social and behaviour change (SBC), Bangladesh

Introduction

The prevalence of malnutrition is high among women of reproductive age in developing countries, including Bangladesh. As the proportion of underweight among reproductive-aged women of Bangladesh has declined from 52% in 1996 to 19% in 2014, nutritional status has improved, but the proportion of overweight has increased from 3% to 24% for the same time interval (NIPORT et al., 2016). Micronutrient deficiencies, especially deficiency of iodine (Shamim et al., 2012) vitamin B_{12}, zinc,(Shamim et al., 2013), and vitamin E (Shamim et al., 2015), are also common among pregnant women in rural Bangladesh.

Lack of dietary diversity is common among the poor in Bangladesh where animal products and fruits are not consumed regularly by pregnant (Shamim, Mashreky, et al., 2016), and lactating women (Na et al., 2016). Evidence suggests that dietary diversity is positively associated with micronutrient adequacy among women of reproductive age in Bangladesh(Arimond et al., 2010). The same was found among lactating mothers in Nepal (Henjum et al., 2015). A recent study showed that dietary diversity of pregnant women is significantly associated with lowering the risk of several adverse pregnancy outcomes such as maternal anemia, preterm delivery, and low birth weight (Zerfu et al., 2016).

Improvement in dietary intake and pregnancy outcomes can be achieved through nutrition- education interventions. For instance, a systematic review by Girard and Olude reported that nutrition education and counseling interventions could significantly improve gestational weight gain (by 0.45 kg), reduce anemia in pregnancy (by 30%), increase birth weight (by 105 g), and decrease the risk of preterm delivery (by 19%) (Girard & Olude, 2012). Another review reported that both protein intake of pregnant women and head circumference of their babies at birth increased, and the risk of having a preterm birth decreased in pregnant

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women when given nutrition advice(Ota et al., 2015). In a study in Bangladesh, Social and behaviour change (SBC) was shown to improve weight gain during pregnancy, improve breastfeeding practices, and reduce low birth weight by 78%(Akter et al., 2012). Therefore, to improve the dietary diversity of pregnant women, FHI 360, an international NGO, initiated a large-scale SBC intervention program in rural Bangladesh called SHIKHA, funded by U.S. Agency for International Development (USAID).

In this study, the effect of the SBC intervention on the dietary diversity of pregnant women in rural Bangladesh was assessed. The effectiveness of such large-scale SBC interventions in improving the diet diversity of pregnant women in South Asia has not been adequately reported and may help in designing programs aimed at improving the diet quality of pregnant women in low and middle-income countries.

Methods

Study design and participants

The SHIKHA program was conducted in 26 sub-districts of 5 districts in southwestern Bangladesh by FHI 360. In this program, all pregnant women identified from November 2013 to March 2016 were exposed to SBC interventions. This evaluation study was designed for before-after comparison; however, a control from non-intervention areas was added after the baseline survey. The study was conducted in 10 randomly selected sub-districts of the SHIKHA intervention area and 4 control sub-districts from non-intervention areas in the 5 program districts. Sampling was done at 3 stages: at stage one, sub-districts were randomly selected from each study district, at stage two, villages were randomly selected from each of the selected sub-districts, and at the final stage, pregnant women were randomly selected from each of the sampled villages, as described in Supplementary Table1. Five hundred and nine women were interviewed at baseline; 516 and 514 women were included at midline from intervention and control areas, respectively; and 2291 women were interviewed at end-line (1275 intervention, 1016 control). (Supplementary Table 1). The sample size at the end-line was higher in order to conduct stratified analysis of adolescent pregnant women as some adolescent indicators showed stagnation between baseline and midline (adolescent nutrition issues will be reported separately).

Intervention

The five core components of the SBC intervention of the SHIKHA project were: i) five home visits during pregnancy; ii) community mobilization involving doctors, religious leaders, and local government representatives; iii) health forum meetings for pregnant women, mothers of children under two, mothers-in-law, and adolescent girls; iv) antenatal and postnatal sessions for pregnant women and mothers of children under two; and v) a mass media campaign. Interpersonal counseling (IPC) was provided by 650 nutrition workers and 5,300 community volunteers through home visits. The volunteers were married women living in the same community with different levels of education. Each community volunteer covered about 250 households. The volunteers received small performance-based incentives for identifying a pregnancy and for counseling women. During the study period, the program enrolled 302,000 pregnant women who were provided IPC. Families were additionally encouraged to motivate the women to eat a diverse diet during pregnancy. Community volunteers identified and registered all pregnant women in their areas through monthly home visits. At the household level, these volunteers used a counseling tool- a specially developed pictorial food plate with four main messages(Shamim, Tegenfeldt, et al., 2016). At the first visit, the community worker demonstrated how to fill a plate for the main meal with foods available at the household in the presence of the household members who were asked to support the pregnant women to eat these foods. In the subsequent home visits, the community worker encouraged the pregnant woman to continue these practices.

Outcome measures

Dietary diversity is measured through a dietary diversity score (DDS), which is a widely accepted tool for measuring diet quality(Arimond et al., 2010). The study measured the improvement of dietary diversity due to the SBC intervention by subtracting the mean DDS at baseline from the mean DDS at midline and end-line. The DDS for each participant in the study was calculated by summing the number of food groups (from nine defined food groups) consumed in the 24 hours before the women were interviewed. An open 24-hour recall method was used to collect types of foods consumed by pregnant women. The nine food groups were described in detail elsewhere(Shamim, Mashreky, et al., 2016). To estimate the effectiveness of the SBC intervention at the individual level, a secondary outcome was set as high dietary diversity (DDS≥5). Another outcome of interest was the improvement of the knowledge score of pregnant women on diet diversity during gestation. Knowledge of dietary diversity during pregnancy was measured by asking the women what type of foods a pregnant woman should consume. The unprompted response was further categorized into 9 food groups and summed to calculate the knowledge score. Study outcome was measured at three time points: baseline, midline, and end-line. The baseline survey was conducted from November 2013 to December 2013, the midline survey from December 2014 to May 2015, and the end-line survey from December 2015 to April 2016.

Data collection

Female interviewers who had at least 5 years of experience in household surveys were assigned to collect data. All received a one-week training prior to each survey, conducted by experienced trainers. Six data collection teams, each consisting of one male supervisor and two female data collectors were deployed. A structured, coded questionnaire was used to collect data from each eligible respondent. Information related to socio-demographic characteristics such as age, education, husband's education, occupation, religion, and the number of household members was elicited. Respondents provided information about food items they consumed during the 24 hours prior to the interview.

Statistical analysis

Age was categorized as ≤19, 20-25 and> 25 yrs. Education was described as functionally illiterate (no formal education) or primary incomplete (1-5 yrs.), secondary incomplete (6-9 yrs.), and secondary complete (≥10 yrs.). The number of household members was classified as ≤3, 4-5, and >5. Gestational age at interview was categorized as 1st trimester (≤ 12 weeks), 2nd trimester (13-27 weeks), and 3rd trimester (>28 weeks). Food security of the household was assessed using the 5-question scale used in the Bangladesh Demographic Health Survey 2011 and classified as food secure if responses to all questions were '0'(NIPORT et al., 2016).

The characteristics of pregnant women between baseline and midline or baseline and end-line using chi-squared tests were compared. The Mean difference of DDS between baseline and midline and baseline and end-line was calculated to estimate the effect of the intervention. The odds ratio (OR) as the unit of effect size for high dietary diversity (DDS≥5) was calculated. To account for the clustering effect (at the village level) we used the generalized estimating equation (GEE). The characteristics which were significantly different between baseline and midline or end-line at p<0.20 were considered as potential confounders and were adjusted using the same GEE model. 95% confidence interval (CI) was calculated and p<0.05 was set for statistical significance.

As the study did not have control at the baseline survey, the study could not use difference-in-differences analysis. However, a control-intervention comparison was done by observing the trends of DDS and knowledge score over 3 years. For this analysis, we combined both the midline and end-line survey data (as there was no duplication). These two surveys were conducted in 3 consecutive years (2014, 2015, and 2016). The midline survey was started in December 2014 and continued until May 2015, and the end-line survey was conducted between December 2015 and April 2016. 173 women (96 intervention, 77 control) were interviewed in 2014, 1035 women (543 intervention, 492 control) in 2015, and 2112 women (1151 intervention, 961 control) in 2016. To ensure demographic and socioeconomic comparability between intervention and control groups, a 1:1 exact propensity score matching was done(Rosenbaum & Rubin, 1983). The propensity score was calculated using logistic regression model(Westreich et al., 2010). Propensity score matching resulted in a total of 997 women from intervention and 997 from control (intervention vs. control over years: 71 vs. 52 in 2014, 385 vs. 282 in 2015, and 540 vs. 663 in 2016). The mean DDS was plotted over the years with 95% CI, with CIs calculated using sandwich estimates of standard error. Two linear trends of intervention and non-intervention groups were compared using the Chow test(Chow, 1960). R version 3.2.5 was used for statistical analysis.

Results

Socio-demographic characteristics of pregnant women are presented in Table 1. Characteristics were comparable between baseline and midline, except for food security. However, only age, education, gestation, and TV ownership were comparable between baseline and end-line. About one-fourth of the participants were adolescents in all three surveys. Functional illiteracy of the participants was 17.0% at baseline, 20.2% at midline, and 15.2% at end-line. The most common husband's occupation was daily wage earner in both the baseline (35.8%) and midline (36.6%); however, business was the most common occupation at the end-line (27.2%). Household size was ≤3 people for 26.5% of households at baseline, 25.6% at midline, and 34.8% at end-line. Most pregnant women in the study were in their third trimester (52.9% at baseline, 48.6% at midline, and 50.0% at end-line). Socio-demographic characteristics were also compared between intervention and non-intervention areas with propensity score matching results presented in Supplementary Table 2. All characteristic variables were comparable between the intervention and control groups.

Table 1. Comparison of socio-demographic characteristics of women included in the baseline, midline, and end-line surveys

Characteristic	Baseline *n* (%)	Midline *n* (%)	End-line *n* (%)
	509 (100)	516 (100)	1275 (100)
Age (years)			
≤ 19	116 (22.8)	118 (22.9)	292 (22.9)
20-25	174 (34.2)	184(35.7)	473 (37.1)
> 25	219 (43.0)	214 (41.5)	510 (40.0)
p-value[1]		0.858	0.434
Education			
Functionally illiterate	87 (17.1)	104 (20.2)	194 (15.2)
Secondary incomplete	309 (60.7)	306 (59.3)	761 (59.7)
Secondary complete	113 (22.2)	106 (20.5)	320 (25.1)
p-value[1]		0.427	0.344
Husband's occupation			
Agriculture	61 (11.9)	61 (11.8)	127 (9.9)
Daily wage earner	182 (35.8)	189 (36.6)	301 (23.6)
Service	85 (16.7)	100 (19.4)	227 (17.8)
Business	118 (23.2)	122 (23.6)	347 (27.2)
Other	63 (12.4)	44 (8.5)	273 (21.4)
p-value[1]		0.315	0.000
Number of household members			
≤ 3	135 (26.5)	132 (25.6)	443 (34.8)
4 - 5	215 (42.2)	236 (45.7)	566 (44.4)
> 5	159 (31.2)	148 (28.7)	266 (20.9)
p-value[1]		0.507	0.000

Table 1. (Continued)

Characteristic	Baseline *n* (%)	Midline *n* (%)	End-line *n* (%)
	509 (100)	516 (100)	1275 (100)
Trimester of pregnancy			
1st trimester	47 (9.2)	72 (13.9)	119 (9.3)
2nd trimester	193 (37.9)	193 (37.4)	519 (40.7)
3rd trimester	269 (52.9)	251 (48.6)	637 (50.0)
p-value[1]		0.054	0.519
Electricity connectivity			
Not connected	178 (34.9)	155 (30.0)	266 (20.9)
Connected	331 (65.0)	361 (70.0)	1009 (79.1)
p-value[1]		0.105	0.000
TV ownership			
Not owned TV	361 (70.9)	359 (69.6)	883 (69.2)
Owned TV	148 (29.1)	157 (30.4)	392 (30.8)
p-value[1]		0.686	0.525
Food security			
Yes	415 (81.5)	466 (90.3)	946 (74.2)
No	94 (18.4)	50 (9.7)	329 (25.8)
p-value[1]		0.000	0.001

[1]*p-value for chi-square test by comparing baseline vs. midline and baseline vs. end-line*

Table 2 presents mean differences in DDS and in knowledge scores of dietary diversity. After adjusting for potential confounders the mean DDS significantly improved by 0.17 units [95% CI: (0.04, 0.30), p=0.008] at midline and by 0.45 units [95% CI: (0.34, 0.57), p<0.001] at end-line. Mean knowledge scores also significantly increased by 1.02 units [95% CI: (0.79, 1.25), p< 0.001] at midline and by 1.68 units [95% CI: (1.51, 1.85), p<0.001] at end-line.

The study found that after adjusting for potential confounders the odds of consuming a more diverse diet at midline was 50% [adjusted OR (95% CI): 1.50 (1.16, 1.94), p=0.002] higher than at baseline. At the end-line, the odds were 2.32 times [adjusted OR (95% CI): 2.32 (1.87, 2.88), p<0.001] compared to the odds at baseline **(Table 3)**. Home visits provided by the community volunteers and workers were 2 per pregnant woman [Median (IQR): 2 (0, 3)] (data are not shown). The study found that knowledge and practice of dietary diversity improved with more household visits in a dose-response manner (data not shown).

Table 2. Effect of intervention on mean knowledge and practice scores of diet diversity among pregnant women

	Mean DDS					Mean knowledge score				
		Crude estimate		Adj. estimate[1]			Crude estimate		Adj. estimate[1]	
	n	Mean difference (95% CI)	p-value	Adj. mean difference (95% CI)	p-value	*n*	Mean difference (95% CI)	p-value	Adj. mean difference (95% CI)	p-value
Overall										
Baseline	509	Ref	-	Ref	-	509	Ref	-	Ref	
Midline	516	0.19 (0.07, 0.32)	0.003	0.17 (0.04, 0.30)	0.008	516	1.03 (0.80, 1.26)	<0.001	1.02 (0.79, 1.25)	<0.001
End-line	1275	0.48 (0.36, 0.59)	<0.00	0.45 (0.34, 0.57)	<0.00	1275	1.68 (1.52, 1.85)	<0.001	1.68 (1.51 1.85)	<0.001

[1,2]Adjusted for husband's occupation, household size, trimester of pregnancy, electricity connectivity, and food security status

Table 3. Effect of intervention on higher dietary diversity of pregnant women

	n	DDS≥5 n (%)	Crude estimate		Adj. estimate[1]	
			OR (95% CI)	p-value	OR (95% CI)	p-value
Overall						
Baseline	509	192 (37.7)	Ref	-	Ref	-
Midline	516	250 (48.5)	1.55 (1.20, 2.00)	0.001	1.50 (1.16, 1.94)	0.002
End-line	1275	748 (58.7)	2.35 (1.89, 2.91)	< 0.001	2.32 (1.87, 2.88)	< 0.001

[1]Adjusted for husband's occupation, household size, trimester of pregnancy, electricity connectivity, and food security status

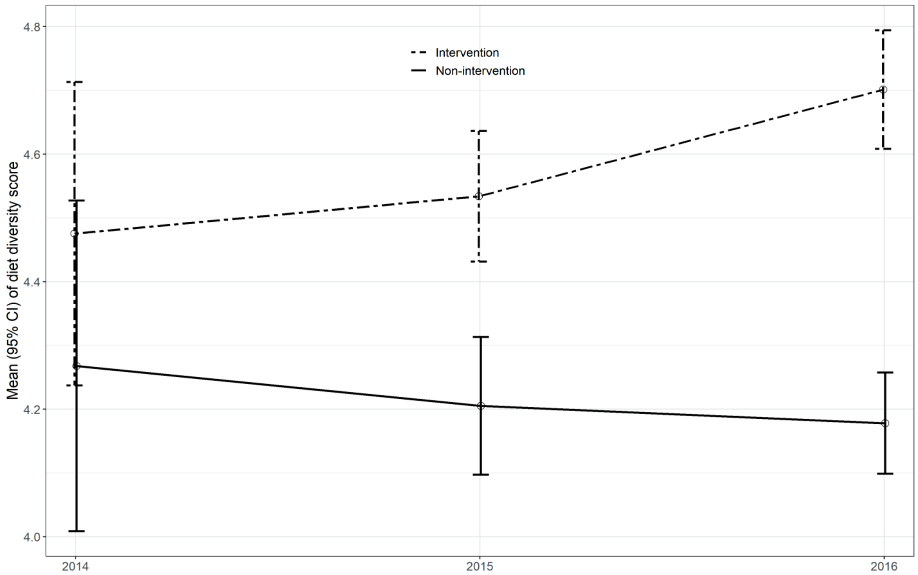
Figure 1 displays the trend in DDS over the three survey points for both intervention and non-intervention areas. The rate of change of mean DDS over the years in the intervention area was significantly ($p<0.001$) higher than in the non-intervention area. In the control areas, mean DDS decreased by 0.10 units per year and increased by 0.20 units per year in the intervention areas; both changes were statistically significant ($p<0.001$).

Figure 2 shows the trend in knowledge scores over the three consecutive years of the intervention for women from both intervention and non-intervention sub-districts. The rate of change of mean knowledge score of dietary diversity in the intervention area was significantly higher than that of the non-intervention areas ($p<0.001$). The rate of change in mean knowledge score was 0.46 units per year for the non-intervention areas and 0.68 units per year for the intervention areas.

Discussion

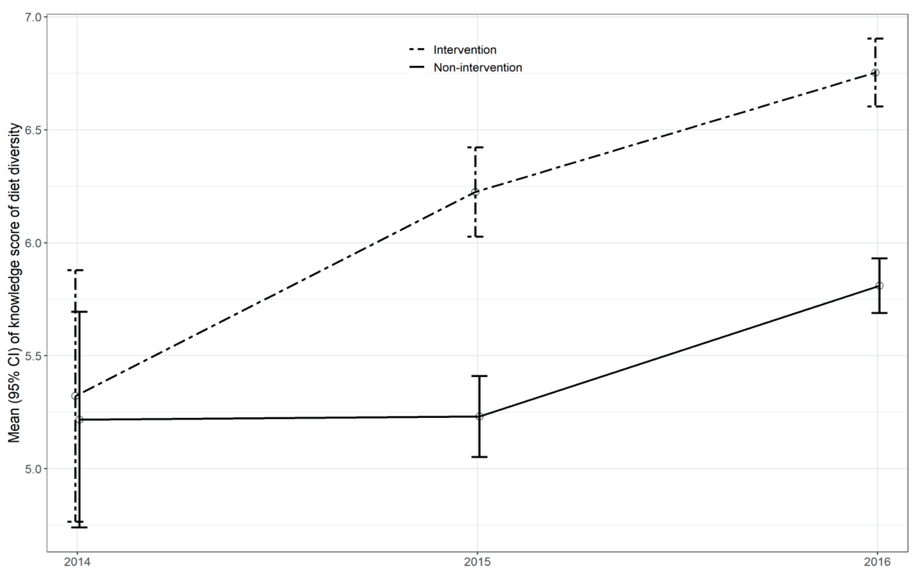
Evaluation of this large-scale SBC intervention provided evidence that it was effective in improving the knowledge and practice of dietary diversity among pregnant women in rural southwest Bangladesh. The effects of this intervention improved significantly over time while DDSs score declined for women from non-intervention areas. The evaluation was conducted after only two years of intervention; the short duration intervention already improved dietary diversity. It is

Figure 1. Effect of SHIKHA intervention on diet diversity score during pregnancy (the two linear trends are significantly different at p<0.001)



The average change of knowledge score over the year was -0.10 units for the control group and 0.20 for the intervention group each year.

Figure 2. Effect of SHIKHA intervention on knowledge score of diet diversity during pregnancy (the two linear trends are significantly different at p<0.001)



The average change of knowledge score over the year was 0.46 units for the control group and 0.68 for the intervention group.

expected that the continuation of the intervention over a longer period would improve the mean DDS among pregnant women as indicated in the trend over time analysis.

Research has shown dietary behaviour, particularly food choice is influenced by different environmental and psychological factors such as socio-economic status, knowledge, beliefs, and perceptions about nutrition and health (Beydoun & Wang, 2008). In our large-scale SBC program setting, improvements within two years of intervention are encouraging and important as these women are at greater risk of consuming a poorer-quality diet (Shamim, Mashreky, et al., 2016). Improvement in such resource-poor settings might be due to the SHIKHA project providing counseling in the presence of influential family members (such as mothers-in-law) and including social mobilization to shift community norms. Pregnant women may have received a greater share of available household resources as a result. These results are consistent with a similar intervention, where even greater improvements were reported, but more frequent home visits were provided (Nguyen et al., 2017).

The study reported that from the baseline data there is a large gap between knowledge and consumption of micronutrient-rich foods like eggs, milk, and leafy vegetables (Shamim, Mashreky, et al., 2016). After two years of intervention, even though the mean knowledge score increased substantially, DDS improved only modestly. This may be due to the affordability and availability of certain food groups. For example, milk may not be affordable in poor households, and consumption may be affected as price or household income varies (Pitt, 1983). Qualitative studies may help deepen our understanding of the barriers associated with the intake of micronutrient-rich foods such as milk, egg, leafy vegetables, and pulses. Future programs for improving diet quality for pregnant women might consider providing support to increase access to micronutrient-rich food through transferring income or increasing production of these foods through homestead production programs (Talukder et al., 2000).

One of the limitations of this evaluation is the lack of baseline data from non-intervention areas. Therefore, difference-in-differences estimates were not calculated; however, data collected from the non-intervention area at midline and end-line facilitated an evaluation of the intervention's effect between these two points. A time-trend comparison between the intervention and non-intervention areas supported that the improvement in knowledge and practice in dietary quality was due to the intervention. The propensity score matching provided more strength to this analysis as it ensured comparable intervention and non-intervention groups.

The study planned to visit each pregnant woman five times during the gestational period to offer IPC, but actual numbers of visits were lower, perhaps since half of the respondents were in their third trimester and the remaining half were still receiving scheduled visits. About 33% of women received no visit for IPC (at the time of the survey), because they may have been too early in their pregnancies to be identified by a community worker.

Implications for research and practice

Pregnant women's requirements for most nutrients are higher than for women and men of similar age (Meyers et al., 2006), so it is important that pregnant women receive attention for improving their diet quality. Overall, this large-scale project, providing SBC using 5 core components with emphasis on IPC through household visits, helped in improving the dietary diversity among pregnant women in rural southwest Bangladesh; how such improvements affect maternal and child health outcomes needs further investigation.

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Supplementary Table 1. Sample selection

Administrative level	Baseline		Midline		End-line	
	Intervention	**Control**	**Intervention**	**Control**	**Intervention**	**Control**
District	5	None	5	2	5	2
Sub-district[1]	5	None	10	4	10	4
Village	251	None	251	130	251	130
Pregnant women	509	None	516	514	1275	1016

[1]At baseline, one sub-district was randomly selected from each of the five program districts while at midline and end-line two sub-districts were selected from each of the five program districts.

Supplementary Table 2. Comparison of pregnant women's socio-demographic characteristics between intervention and control areas before and after matching

Characteristic	Before matching			After propensity score matching		
	Control n (%)	Intervention n (%)	p-value[1]	Control n (%)	Intervention n (%)	p-value[1]
N	**1530**	**1791**		**997**	**997**	
Age (years)						
≤ 19	476 (31.1)	410 (22.9)		257 (25.78)	257 (25.78)	1.000
20-25	493 (32.2)	657 (36.7)		357 (35.81)	357 (35.81)	
> 25	561 (36.7)	724 (40.4)	<0.001	383 (38.42)	383 (38.42)	
Education						
Functionally illiterate	346 (22.6)	298 (16.6)		182 (18.25)	182 (18.25)	1.00
Secondary incomplete	719 (46.9)	1067 (59.6)		565 (56.67)	565 (56.67)	
Secondary complete	465 (30.4)	426 (23.8)	<0.001	250 (25.08)	250 (25.08)	
Husband's occupation						
Agriculture	148 (9.7)	188 (10.5)	0.005	91 (9.13)	91 (9.13)	1.00
Daily wage earner	487 (31.8)	490 (27.4)		311 (31.19)	311 (31.19)	
Service	234 (15.3)	327 (18.3)		162 (16.25)	162 (16.25)	
Business	358 (23.4)	469 (26.2)		253 (25.38)	253 (25.38)	
Other	303 (19.8)	317 (17.7)		180 (18.05)	180 (18.05)	
Household size						
≤ 3	470 (30.7)	575 (32.1)	0.588	317 (31.80)	327 (32.80	0.663
4 – 5	687 (44.9)	802 (44.8)		449 (45.04)	429 (43.03)	
> 5	373 (24.4)	414 (23.1)		231 (23.17)	241 (24.17)	
Trimester of pregnancy						
1st trimester	98 (6.4)	191 (10.7)	<0.001	48 (4.81)	48 (4.81)	1.00
2nd trimester	698 (45.6)	712 (39.8)		434 (43.53)	434 (43.53)	
3rd trimester	734 (47.9)	888 (49.6)		515 (51.65)	515 (51.65)	
Electricity connectivity						
Not connected	559 (36.5)	421 (23.5)	<0.001	268 (26.88)	268 (26.88)	1.00
Connected	971 (63.5)	1370 (76.5)		729 (73.12)	729 (73.12)	
TV ownership						
Not owned TV	1259 (82.3)	1242 (69.4)	<0.001	783 (78.54)	783 (78.54)	1.00
Owned TV	271 (17.7)	549 (30.7)		214 (21.46)	214 (21.46)	
Food security						
Secured	1454 (95.0)	1412 (78.9)	<0.001	940 (94.28)	940 (94.28)	1.00
Unsecured	76 (4.9)	379 (21.2)		57 (5.72)	57 (5.72)	

[1]p-value for chi-square test