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Association between dietary diversity and complications during pregnancy in a South-West District of Bangladesh

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ABSTRACT

Introduction: Poor dietary diversity is one of the key factors that increases the rate of complications during pregnancy. Pregnancy complications significantly increase the risk of maternal mortality. The aim of this study was to explore the associated factors between dietary diversity and complications during pregnancy. **Method:** A cross-sectional study was conducted among 450 randomly selected pregnant women. Individual dietary diversity score (IDDS) was used to assess dietary diversity based on Food Frequency Questionnaire (FFQ). IDDS was derived from 24-hour recalls from nine food groups. **Results:** Most of the pregnant women (48.9%) included in this study were in their second trimester; 19.3% and 31.8% were in first trimester and third trimester, respectively. About 83.8% of respondents included in this study experienced pregnancy complications. According to IDDS, most participants (77.1%) consumed a medium-diversified diet. Only 4.4% and 18.4% of pregnant women had low and highly diversified dietary intakes, respectively. Mean IDDS was 5.62±0.93, which indicated medium diversity of dietary intake. Dietary diversity had a statistically significant correlation with age (p=0.003), monthly income (p=0.003), education level (p=0.001), and respondent's employment (p=0.004). The study exposed that pregnancy complications had a negative correlation with food diversity (r=-0.223), marriage age (r=-0.066), and education level (r=-0.163). **Conclusion:** The study concluded that pregnancy complications can be alleviated by improving dietary diversity practices during pregnancy.

Keywords: dietary diversity, maternal mortality, pregnancy complications

INTRODUCTION

Every year, over thirty thousand pregnant women die and 9.5 million women around the world suffer complications during and after pregnancy, resulting in serious socioeconomic difficulties (Hogan *et al.*, 2010; Islam & Sultana, 2019). The rate of pregnancy complications is increasing day by day all over the world because of poor dietary diversity (DD), nutritional and lifestyle practices, marriage age, number of meals consumed, occupation, and women's education (Nana & Zema, 2018; Gao *et al.*, 2013). In low- and middle-income countries, nutritional deficiencies are still a significant threat to public health, particularly for pregnant women (Desta *et al.*, 2019). The health problems that arise during pregnancy are to blame for almost two-thirds of maternal deaths (Say *et al.*, 2014).

Anaemia, hepatitis B, haemorrhage, preeclampsia, constipation, heart

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problems, liver disease, excessive vomiting, and visual impairment are considered common health problems among women during pregnancy (Gomes *et al.*, 2018). Moreover, palpitation, high fever, and pregnancy-related gestational diabetes are also concerns (Mahabub *et al.*, 2009). Pregnancy complications significantly raise the chances of maternal mortality and other long-lasting health problems (Gernand *et al.*, 2016).

Pregnancy is an important stage of a woman's life cycle. Proper DD during pregnancy is significant for both the mother and the foetus (Ding *et al.*, 2021). Maternal diet serves as a nutrient source for the rapid growth of the foetus and mother's health (Ahmed *et al.*, 2019). Women's nutritional needs are increased during pregnancy because of the increased demands placed on the mother and her growing foetus (Marangoni *et al.*, 2016). A humdrum diet impedes the availability of numerous nutrients, resulting in malnutrition and micronutrient deficiencies (Allen, 2008). During pregnancy, adequate DD increases the availability of macro- and micronutrients that improves the health status of women.

At both the individual and household levels, DD can be evaluated. Household dietary diversity (HDD) is a substitute indicator of access to food in the home. On the other hand, individual dietary diversity (IDD) reflects the diet's sufficiency for nutrients (Kennedy *et al.*, 2013). In comparison to other developing nations, Bangladesh has a higher rate of undernutrition among pregnant women because of their food group choice behaviours or lack of proper knowledge about dietary intake (Osmani & Sen, 2003; Kundu *et al.*, 2021). Low financial stability indexes, a lack of schooling, and unemployment are the main factors that cause lower DD in Bangladesh (Kundu *et al.*, 2021). Pregnancy complications are the main reason for 99% of maternal deaths in developing or low-income nations (Hossain *et al.*, 2014). In developing nations, women who live in rural areas have higher rates of maternal mortality than in urban areas (Castillo *et al.*, 2017). According to a study, 194 maternal deaths occur for every 10,000 pregnant women in Bangladesh (Hossain *et al.*, 2014).

The leading reasons for maternal deaths in Bangladesh are pregnancy haemorrhage (29%), eclampsia (24%), obstructed labour (10%), and abortion (5%) (Mayén *et al.*, 2014). Pregnancy complications and maternal mortality rates can be minimised by DD, improvement of women's socioeconomic status, increased birth space, and increased education level among women (Mahabub *et al.*, 2019). According to studies, there has been little change worldwide in the past 30 years in the mortality rate of pregnant women due to inadequate diet or malnutrition during pregnancy (Smith *et al.*, 2017). By addressing information and reducing adherence obstacles, the condition of pregnant women's food diversity would need to be responsibly enhanced. However, Bangladesh does not currently have any research in the relevant field.

Eating disorders and inadequate dietary habits are common during the pregnancy period. Several research findings that have looked at how eating disorders or poor DD affected pregnancy complications and neonatal outcomes have reported pregnancy complications or deaths (Stewart *et al.*, 2017). Waugh & Bulik (2019) conducted interviews with ten pregnant women who were currently or in the past had eating disorders, as well as ten comparison women and their offsprings. Their results found that babies born to eating-disordered mothers had considerably lower birth weights and lengths than babies born to comparison women. Proper DD and maternal nutrition can indeed provide greater benefits to minimise pregnancy complications

and maternal mortality rate (MMR) (Lee *et al.*, 2013). It is important to concentrate on the risk variables for pregnancy complications and reducing MMR to 70 for every 10,000 pregnant women, in fulfilment of the Sustainable Development Goals (SDGs) (Hossain *et al.*, 2023).

Understanding the factors that contribute to pregnancy complications and related deaths in Bangladesh is therefore essential for reducing maternal mortality rate. The health of the mother and her newborn are closely related; proper DD may reduce pregnancy complications and result in lower maternal and neonatal mortality rates. Unfortunately, there has been little research on DD and its associated complications during pregnancy in Bangladesh. So, it is important to concentrate in this area of work so that a plan can be created to lower maternal and child mortality in order to meet the SDGs. Therefore, the main goal of the study was to explore DD and the complications associated with pregnancy in the Jashore district of Bangladesh.

MATERIALS AND METHODS

Study design and setting

A community-based cross-sectional study was designed to determine the association between DD and the complications among pregnant women in Jashore district, Bangladesh. The study was conducted among pregnant women from October 2022 to January 2023. A convenient random sampling method was applied to collect data from pregnant women. Data were collected from pregnant women through direct face-to-face interviews. Relevant data were gathered from community clinics and other health facility disciplines in the Jashore district where pregnant women attended and were being treated during pregnancy. Data were collected only from pregnant women who were willing to be part of the study. Both urban and rural participants were included in this study. Pregnant women and those who were capable of communicating easily were the main target respondents for the study.

Questionnaire development and explanatory variables

The research team performed direct face-to-face interviews during pre-testing of the questionnaire to verify the flow of the questions, its accuracy, skip trends, add/drop some questions or answer options. The field research observation was shared among members of the team and the valued supervisor to significantly adapt the questionnaire. The questionnaire was divided into three parts: I) socio-demographics information, II) DD, and III) pregnancy complications. A paper-based, pre-tested questionnaire was used and the socio-demographic variables taken into account were: respondent's residence (rural, urban, and slum), age in years (≤20, 21-30, 31-40, and ≥41), frequency of pregnancy (1, 2-3, and >3), trimester (first, second, and third), family members (≤3, 4-5, and ≥6), monthly income (BDT<10000, 10001-20000, and >20000; 1 US dollar = 99.0482 BDT)(October 3, 2022), pregnant women's education level (illiterate, secondary, higher secondary, and above higher secondary), pregnant women's husband's education level (illiterate, secondary, higher secondary, and above higher secondary), respondent's employment (housewife, non-government job, government job, business), family earning number (1, 2, and ≥3), marriage age in years (<20, 20-30, and >30), pregnancy complications (yes and no). DD included nine major food groups. Different types of pregnancy complications experienced by the women during their pregnancy were considered, namely anaemia (iron deficiency anaemia), hepatitis B, heart disease, breathing problem, liver problem, oedema, excessive vomiting (hyperemesis gravidarum), palpitation,

abdominal pain, visual impairment, haemorrhage, preeclampsia, constipation, and gestational diabetes (gestational diabetes mellitus) (Hossain *et al.*, 2023). The accuracy of the data was verified against their medical cards or family members prior to data collection.

Sample size

The study population consisted of pregnant women. A community-based, cross-sectional study was designed among selected pregnant women. Due to the inadequate number of studies on this subject, the sample size was determined using a 95% response rate, a 95% confidence level, and a 5% margin of error. Based on this, 500 pregnant women were initially chosen for interviews from a list of pregnant women at a nearby community clinic. However, some of them who opted to participate in the study provided no information. Consequently, a total of 450 pregnant women were chosen in this study after those without information were removed. Face-to-face interviews were conducted in order to obtain accurate information from the Jashore district's rural and urban areas.

Data collection procedures and quality control

A self-designed, paper-based affirmed questionnaire was applied to gather data from pregnant women. The questionnaire was divided into three sections: socio-demographic variables, DD, and pregnancy complications. Participant's consent was asked before conducting the interview. All interviewers who were selected for data collection were students from the Nutrition and Food Technology department. All interviewers had past experience collecting data from public health surveys. Interviewers attended a training session before recruiting data (technique, consideration, tools, and data collection).

A pre-selected interview schedule was given to every pregnant woman. The time allotted for responses to each question was sufficient for the respondents. Initial versions of the paper-based survey questionnaire were written in English. In the prior interview, all questions were translated into the participant's native language (Bengali) to reduce bias and misconstrued interpretations. The interviewer assured respondents that the data collected were only used for this study and that their contact location or name would not be revealed publicly. An opportunity was given to the respondents to ask any questions regarding this study and they could leave or stop the interview at any moment they wished. The sample size for the pre-tested questionnaire was 40 pregnant women. After each day's field work, the completed questionnaires were double-checked. If any mistakes were found, the data were then corrected.

Pregnant women 24-hour individual dietary diversity score (IDDS) measurement

Using a paper-based, structured questionnaire, pregnant women were questioned individually about their eating habits or DD for the last 24 hours. Nine main food groups were examined, namely cereals, eggs, dairy, meat or fish, dark green vegetables, pulses or nuts, vitamin-A-rich fruits, organ meat, and other fruits and vegetables (Ahmed *et al*,.2019; Kennedy *et al.*, 2013). Every food group conferred 1 (one) point. IDDS was determined using the respondents' total responses to different dietary groups available for consumption in the last 24 hours. Individual pregnant woman could output a maximum of 9 (nine) points if they reportedly ate all food groups within the reference time. Dietary intake from <4 food groups was considered a low dietary diversity score. On the other hand, 4-6 food groups intake and >6 food groups intake were

considered moderate and high dietary diversity scores, respectively (Ahmed *et al.*, 2019; Kundu *et al.*, 2021).

Ethical approval and consent to participate

The Ethical Review Committee, Faculty of Biological Science and Technology, Jashore University of Science and Technology, Jashore-7408, Bangladesh provided the ethical approval to conduct this study. The study participants were reassured by the researchers that their names would not be recorded or mentioned in this study. Written informed consent from each participant was obtained before data collection by explaining the purpose and methods of the study, as well as the risks and benefits of participation in the study.

Data entry and analysis

Data from the final checked questionnaire were entered into IBM SPSS Statistics for Windows version 25.0 software (IBM Corp., Armonk, NY, USA), and data entry was carefully done to avoid errors. To explore the relationship across potential associated factors with socio-demographic information, DD, and pregnancy complications, frequency, percentage, mean, median, standard deviation, frequency distribution, Chi-square test, Pearson linear correlation, and Spearman's correlation were used. The confidence interval level was 95% and statistical significance was set at p-value <0.05.

RESULTS

Table 1 describes the socio-demographic characteristics of pregnant women in the study. A total of 450 pregnant women were included in this study. Results showed that 45.6% (n=205) and 46.7% (n=210) pregnant women were from rural and urban areas, respectively. Only 7.8% (n=35) pregnant women were found to live in the slum. Most of the pregnant women (48.2%, n=217) were in the 21–30 years age group. Only 30.4% (n=137) of pregnant women reported being pregnant for the first time. It was found that most of the respondents (48.9%, n=220) were in their second trimester; 19.3% (n=87) and 31.8% (n=143) were found to be in their first and third trimesters, respectively. Only 29.1% (n=131) of respondents were found to live in a joint family with more than six family members. Most of the respondents (40.4%, n=182) reported having a monthly family income greater than 20,000 taka. It was found that most of the pregnant women (42.4%, n=191) and their husbands (36.6%, n=166) were illiterate. Only 17.9% (n=80) pregnant women had a higher secondary education level. More than half of the pregnant women were found to be housewives (65.1%, n=293). The other respondents were from other occupations such as non-government job (3.8%, n=17), government job (25.6%, n=115), and business (5.5%, n=25). More than half of the respondents (56.7%, n=255) were found to have two earning members in their families. It was found that about 42.9% (n=193) of respondents married during their adolescent period and about 48.4% (n=218) got married when they were between 20 and 30 years old. Only 8.7% (n=39) pregnant women were found to be married at the age of above 30 years. It was also found that most of the pregnant women (83.8%, n=377) experienced complications during their pregnancy. Only 16.2% (n=73) of respondents were found to have had no complications during pregnancy.

Figure 1 depicts that the mean IDDS value obtained by all respondents was 5.62±0.93, indicating a medium-diversity diet in terms of DD. The median, or 50th percentile, of IDDS was 6. The median value indicated that about half of the pregnant women consumed food from six or fewer food groups. Among the nine different food groups, it was found that the maximum and minimum number of food groups taken by any

Table 1. Socio-demographic characteristics of pregnant women in the Jashore district

Characteristics	*Frequency (n)*	*Percentage (%)*
Living area		
Rural	205	45.6
Urban	210	46.7
Slum	35	7.8
Age of respondent (years)		
≤20	105	23.3
21-30	217	48.2
31-40	96	21.3
≥41	32	7.1
Frequency of pregnancy		
1	137	30.4
2-3	186	41.3
>3	127	28.3
Trimester		
First	87	19.3
Second	220	48.9
Third	143	31.8
Family members		
≤3	96	21.3
4-5	223	49.6
≥6	131	29.1
Monthly family income (BDT)		
<10000	112	24.9
10001-20000	156	34.7
>20000	182	40.4
Education level (Respondent)		
Illiterate	191	42.4
Secondary	92	20.4
Higher secondary	87	19.3
Above higher secondary	80	17.9
Education level (Respondent's husband)		
Illiterate	166	36.9
Secondary	102	22.7
Higher secondary	52	11.7
Above higher secondary	130	28.9
Respondent's employment		
Housewife	293	65.1
Non-government job	17	3.8
Government job	115	25.6
Business	25	5.5
Number of family members with income		
1	137	30.4
2	255	56.7
≥3	58	12.9
Marriage age (years)		
<20	193	42.9
20-30	218	48.4
>30	39	8.7
Pregnancy complications		
Yes	377	83.8
No	73	16.2

BDT= Bangladeshi Taka; USD 1 = BDT 99.0482 (October 3, 2022)

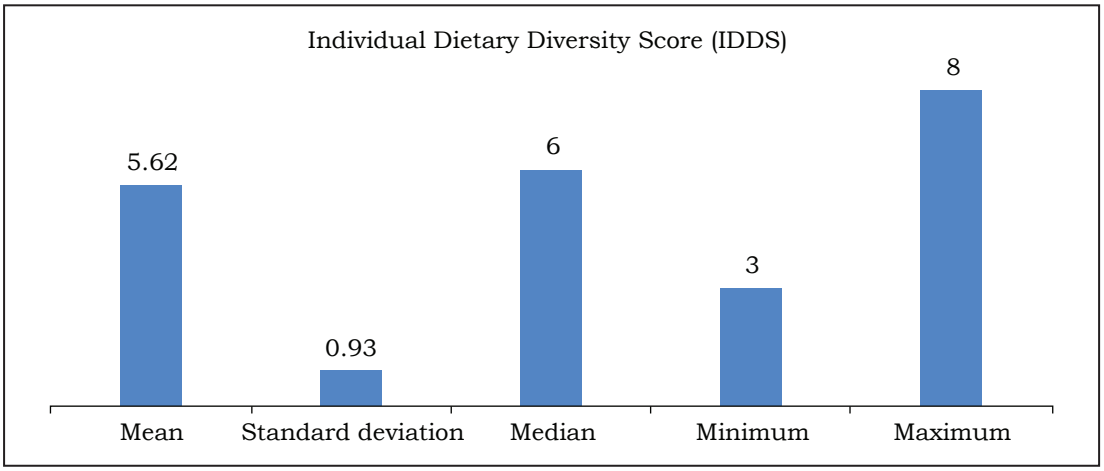

Figure 1. Mean, standard deviation, median, minimum, and maximum Individual Dietary Diversity Score (IDDS) values of pregnant women

individual pregnant woman were 8 and 3, respectively. The results showed that most of the pregnant women (77.1%, *n*=347) had a medium-diversity dietary intake, indicating that they consumed from four to six diverse food groups. In contrast, only 4.4% (*n*=20) of pregnant women had low-diversity dietary intake as they consumed from less than four different food groups. On the other hand, about 18.4% (*n*=83) of respondents consumed food from more than six different food groups, which was referred to as high-diversity dietary intake.

Table 2 shows the effect of socio-demographic characteristics on the DD of pregnant women (*N*=450). It was revealed that respondents living in rural (82.9%, *n*=170), urban (76.7%, *n*=166), and slum (45.7%, *n*=16) areas mostly consumed a medium-diverse diet. The age of the respondent was found to be associated with DD (p=0.003). Pregnant women of different age groups were found to consume a moderately diverse diet. The percentages of pregnant women who consumed a moderately diverse diet were 73.3% (*n*=77), 82.5% (*n*=179), 67.7% (*n*=65), and 81.25% (*n*=26) for age groups ≤20 years, 21–30 years, 31–40 years, and ≥41 years, respectively. Majority of pregnant women (78.1%, *n*=107) were found to consume a medium-diversified diet during their first pregnancy. On the other hand, 72.6% (*n*=135) and 83.5% (*n*=106) of pregnant women were found to consume diets with medium DD. It was found that respondents from different trimesters had mostly taken a medium-diverse diet. The percentages of pregnant women who consumed a moderately diverse diet in their first, second, and third trimesters were 67.8% (*n*=59), 77.3% (*n*=170), and 82.5% (*n*=118), respectively. There was no association between the number of family members among the respondents and DD. All the respondents, irrespective of their family members, consumed a moderately diverse diet. However, monthly family income, education level, and employment status of respondents were found to be associated with DD (p<0.05). Accordingly, 76.8% (*n*=86), 76.3% (*n*=119), and 78.1% (*n*=142) of pregnant women with monthly family income of <10,000 taka, 10,001-20,000 taka, and >20,000 taka were found to consume a diet with medium diversity. It was found that pregnant

Table 2. Effect of socio-demographic characteristics on dietary diversity of pregnant women

Characteristics	*Number of pregnant women n (%)*			*p-value*	*Mean±SD*
	Low (<4 food groups)	*Medium (4 to 6 food groups)*	*High (> 6 food groups)*		
Living area				0.521	
Rural	8 (3.9)	170 (82.9)	27 (13.2)		68.33±10.13
Urban	0 (0.0)	161 (76.7)	49 (23.3)		70.34±9.64
Slum	12 (34.3)	16 (45.7)	7 (20.0)		69.51±12.21
Age of respondent (years)				0.003***	
≤20	8 (7.6)	77 (73.3)	20 (19.1)		70.62±9.43
21-30	2 (0.9)	179 (82.5)	36 (16.6)		71.19±11.72
31-40	9 (9.37)	65 (67.7)	22 (22.9)		68.82±13.11
≥41	1 (3.1)	26 (81.25)	5 (15.6)		70.96±8.37
Frequency of pregnancy				0.679	
1	7 (5.1)	107 (78.1)	23(16.8)		69.55±12.10
2-3	8 (12.4)	135 (72.6)	43 (23.1)		68.43±10.09
>3	5 (3.9)	106 (83.5)	17 (13.4)		70.56±8.13
Trimester				0.872	
First	7 (8.1)	59 (67.8)	21 (24.1)		74.18±7.56
Second	11 (5)	170 (77.3)	39 (17.7)		73.51±6.12
Third	2 (1.4)	118 (82.5)	23 (16.1)		72.34±8.78
Family members				0.470	
≤3	0 (0.0)	55 (57.3)	41 (42.7)		71.10±9.72
4-5	6 (2.7)	195 (87.5)	22 (9.8)		78.16±12.89
≥6	14 (10.7)	97 (74.1)	20(15.2)		76.50±11.3
Monthly family income (BDT)				0.003***	
<10000	13 (11.6)	86 (76.8)	13 (11.6)		76.52±11.32
10001-20000	6 (3.8)	119 (76.3)	31 (19.9)		65.13±9.71
>20000	1 (0.5)	142 (78.1)	39 (21.4)		71.50±11.32
Education level (Respondent)				0.001***	
Illiterate	13 (6.8)	171 (89.5)	7 (3.7)		69.87±70.80
Secondary	5 (5.4)	69 (75.0)	18 (19.6)		68.56±13.37
Higher secondary	2 (2.3)	63(72.4)	22 (25.3)		73.20±13.72
Above higher secondary	0 (0.0)	44 (55.0)	36 (45.0)		70.10±11.94
Respondent's employment				0.004***	
Housewife	14 (4.8)	268 (91.5)	11 (3.8)		81.67±12.73
Non-government job	4 (23.5)	5 (29.4)	8 (47.1)		73.30±9.12
Government job	0 (0.0)	61 (53.1)	54 (46.9)		70.12±13.78
Business	2 (8.0)	13 (52.0)	10 (40.0)		66.35±9.07
Number of family members with income				0.872	
1	12 (8.8)	112 (81.8)	13 (9.4)		71.50±7.90
2	6 (2.5)	219 (85.9)	30 (11.7)		66.83±9.97
≥3	2 (3.4)	16 (27.6)	40 (69.0)		68.66±11.32
Marriage age (years)				0.921	
<20	13(6.7)	148 (76.7)	32 (16.6)		65.59±10.01
20-30	5 (2.3)	163 (74.8)	50 (22.9)		70.52±9.71
>30	2 (5.1)	36 (92.3)	1(2.6)		71.62±13.13
Have any pregnancy complications				0.734	
Yes	18 (4.8)	336 (89.1)	23 (6.1)		79.68±13.11
No	2 (2.7)	11 (15.1)	60 (82.2)		76.42±11.94

Chi-square test was used to measure *p*-value; $p<0.05$ is statistically significant
***indicates 1% significance level ($p<0.01$)

women with different education levels mostly consumed a medium-diversified diet. Most of the respondents who were housewives (91.5%, *n*=268) reported consuming a moderately diversified diet. Respondents working in non-government jobs (47.1%, *n*=8) were found to consume a highly diversified diet. On the other hand, pregnant women with government jobs (53.1%, *n*=61) and pregnant women with business (52%, *n*=13) were found to consume a diet with medium diversity. This study found that 81.8% (*n*=112) and 85.9% (*n*=219) of pregnant women who consumed a moderately diverse diet had only one or two earning members in their families, respectively. However, about 69% (*n*=40) of respondents were found to have high DD and had three earning members in their families. It was found that there was no association between the age of marriage and DD. Most of the respondents had medium dietary diversity. The percentages of medium DD were 76.7% (*n*=148), 74.8% (*n*=163), and 92.3% (*n*=36) for respondents who married at the ages of less than 20 years, 20–30 years, and above 30 years, respectively. Most of the pregnant women who answered affirmatively about complications during pregnancy were found to have medium DD. On the other hand, it was found that 82.2% (*n*=60) of pregnant women had high DD and reported that they had no complications during pregnancy.

Table 3 displays the complications during pregnancy suffered by pregnant women in the first, second, and third trimesters of their pregnancy. Mean values of pregnancy complications among pregnant women were distributed according to low, medium, and high IDDS. Mean value for prevalence of anaemia among pregnant women was higher in the low DD group than in the medium and high DD groups. Heart disease and liver disease were more prevalent in low-DD pregnant women than in the medium- and high-DD groups. Consequently, pregnant women in the lower DD group had higher rates of constipation, preeclampsia, oedema, haemorrhage, visual impairment, and palpitation compared to the higher DD and medium DD groups. Interestingly, in this study, no respondents had gestational diabetes, though they were from low-DD group. Overall, the mean values of pregnancy complications among pregnant women were higher in the low-DD group than in the medium- and high-DD groups.

The links between food diversity score, various socio-demographic factors, and pregnancy complications are shown in Table 4. Pregnant women's food diversity was found to be positively correlated with education level (r=0.275^{b**}), family members (r=0.218^{b**}), and number of pregnancy (r=0.030^{b}). Food diversity exhibited a negative correlation with respondent's occupation (r=-0.182^{b*}). Pregnancy complications exhibited a negative relationship with food diversity (r=-0.223^{a**}), marriage age (r=-0.066^{b}), and education level (r=-0.163^{b*}). Pregnant women's occupation had a positive and significant (r=.001^{a*}) correlation with pregnancy complications, whereas the number of pregnancy had no relationship with complications during pregnancy. However, food diversity was negatively connected with pregnancy complications, so it is reasonable to assume that increasing food diversity among pregnant women will decrease pregnancy complications.

DISCUSSION

A balanced diet plan should adhere to the dietary recommendations for eating a wide range of foods to obtain vitamins, minerals, carbohydrates, protein, and fat from multiple sources. A variety of cereals, nuts, whole grains, dark green leafy vegetables, organ meats

Table 3. Relationship between pregnancy complications and dietary diversity of pregnant women

Complication	*Dietary diversity*	*Number of participants*	*Mean±SD*	*p-value*
Anaemia	Low	11	0.98±0.13	0.062
	Medium	106	0.76±0.12	
	High	3	0.58±0.21	
Hepatitis B	Low	9	0.73±0.10	0.182
	Medium	66	0.70±0.08	
	High	4	0.62±0.21	
Heart disease	Low	3	0.78±0.11	0.056
	Medium	45	0.67±0.20	
	High	7	0.49±0.10	
Breathing problem	Low	5	0.87±0.13	0.070
	Medium	41	0.78±0.17	
	High	3	0.65±0.13	
Liver disease	Low	0	0.00±0.00	0.213
	Medium	30	0.78±0.23	
	High	8	0.70±0.25	
Oedema	Low	9	0.78±0.17	0.319
	Medium	123	0.74±0.16	
	High	15	0.70±0.23	
Excessive vomiting	Low	7	0.85±0.35	0.227
	Medium	191	0.79±0.27	
	High	15	0.71±0.26	
Palpitation	Low	5	0.73±0.16	0.720
	Medium	61	0.72±0.10	
	High	21	0.61±0.18	
Lower abdominal pain	Low	13	0.78±0.21	0.328
	Medium	72	0.74±0.25	
	High	22	0.59±0.19	
Visual impairment	Low	6	1.69±0.52	0.082
	Medium	50	1.35±0.61	
	High	17	1.10±0.55	
Haemorrhage	Low	3	0.70±0.18	0.057
	Medium	39	0.61±0.11	
	High	15	0.51±0.12	
Preeclampsia	Low	8	0.71±0.24	0.612
	Medium	24	0.66±0.30	
	High	7	0.50±0.29	
Constipation	Low	11	0.69±0.10	0.054
	Medium	120	0.58±0.14	
	High	29	0.49±0.10	
Gestational diabetes	Low	0	0.00±0.00	0.328
	Medium	64	0.95±0.29	
	High	17	0.59±0.19	

Frequency distribution analysis was used to measure p-value; $p<0.05$ is statistically significant

Table 4. Associations between demographic factors with food diversity score and pregnancy complications

Variables	*Age*	*Occupation*	*EL*	*NP*	*FM*	*MA*	*FD*	*PC*
Age	1[b]							
Occupation	-0.149[b*]	1[b]						
EL	-0.072[b]	-0.274[b**]	1[b]					
NP	0.654[b**]	-0.096[b]	-0.057[b]	1[b]				
FM	-0.033[b]	-0.017[b]	-0.089[b]	0.030[b]	1[b]			
MA	0.029[b]	-0.129[b]	-0.019[b]	0.010[b]	0.031[b]	1[b]		
FD	0.038[b]	-0.182[b*]	0.275[b**]	0.030[b]	0.218[b**]	0.021[b]	1[a]	
PC	-0.063[b*]	0.001[a*]	-0.163[b*]	0.000[b]	0.023[b]	-0.066[b]	-0.223[a**]	1[a]

EL: Education level; NP: Number of pregnancy; FM: Family member; MA: Marriage Age; FD: Food diversity; PC: Pregnancy complication

[a]Pearson linear correlation; [b]Spearman's correlation; significant at $p<0.05$ (2-tailed), significant at $p<0.01$ (2-tailed)

or fish, dairy or dairy products, and their substitutes have been found to be strongly linked to a reduced risk among all causes of death and significantly improve health conditions (Sharma *et al.*, 2021). The findings of this study demonstrated that during pregnancy, most pregnant women failed to maintain their DD guidelines. This study's results showed that only 18.4% of the total respondents consumed more than six food groups (> 6), which revealed that they practised high IDD and this percentage was very low. On the other hand, about 81.5% of the total pregnant women in this study did not receive adequate DD. This prevalence is similar to another local study in Bangladesh (Nguyen *et al.*, 2017), but higher than a study in Ethiopia (74.6%) (Desta *et al.*, 2019). Different DD could be attributed to these findings. All of the respondents in this study consumed cereals (whole grains, starchy foods, etc.). On the other hand, participants consumed fewer eggs (54.9%), dairy and dairy products (65.6%), meat or fish (63.1%), nuts and seeds (32%), and fruits and vegetables (60%) in the previous 24 hours. The findings of this study were almost the same as previous findings in Bangladesh (Nguyen *et al.*, 2017) and Tanzania (Desta *et al.*, 2019). This could be reasons for society's culture, lifestyle, low level of animal product access to families, or low family income to afford animal products. These findings suggest that pregnant women who ate fewer animal products (meat, poultry, lean meat, and dairy products) may experience greater pregnancy complications. Therefore, avoiding animal products may result in lower IDD scores, which increases the risk of pregnancy complications in women. Moreover, pregnancy complications are not only associated with this; they are also influenced by many other factors. Women who have low IDDS during pregnancy tend to be exposed to more pregnancy complications during pregnancy than those who have high IDDS. A similar finding was found in Ethiopia (Delil *et al.*, 2018). This could be because the pregnancy period serves as the most essential DD demanding period in a mother's life. Therefore, women are highly recommended for dietary diversification to meet their nutritional requirements during the pregnancy period.

The education level of pregnant women is the single most important determinant of sufficient IDD. It was found that, in comparison to the level

of education, increasing educational status was strongly associated with adequate DD. This finding is consistent with a similar study in Bangladesh (Islam & Sultana, 2019; Hossain *et al.*, 2023). The reason for this could be that pregnant mothers with higher level of education are more likely to obtain knowledge about individual dietary needs and can easily comprehend educational messages spread through various media. For this reason, it is anticipated that the proportion of pregnant women consuming an adequate variety of foods will increase as education levels rise (Mayén *et al.*, 2021). According to this study, the likelihood of consuming a sufficient variety of dietary items increased along with increased household income. Pregnant women with higher incomes per month tend to have higher IDD compared to low-income pregnant women or the jobless. This could be explained by the fact that pregnant women with relatively high monthly incomes have more buying power and may be capable of paying for a variety of foods as compared to lower-income pregnant women. A similar result was found in another study in Bangladesh (Hossain *et al.*, 2023).

This research resembled a study carried out in Kenya (Kiboi *et al.*, 2017). About half of the Bangladeshi women marry before they turn 18 years old (Islam & Sultana, 2019) and the prevalence of teenage pregnancies is rising as a result of early marriages. According to this study, pregnant women who gave birth at a young age (under 18 years) experienced more pregnancy-related difficulties. Additionally, women who were having their first child experienced more pregnancy complications. A similar report was found in another study in Bangladesh (Akhter *et al.*, 2015).

The food groups that participants had consumed over the previous 24 hours were used to determine the IDDS in this study. To investigate the caliber of pregnant women's diets, IDDS was used. The IDDS in this study was found to be 5.62±0.93, which indicated medium DD among respondents. A similar study was conducted in Bangladesh (Tiwari *et al.*, 2013) and the IDDS was found to be 4.02±1.28. In this study, the maximum level of IDDS among respondents was 8 and the minimum score was 3. A similar study conducted in Bangladesh found minimum and maximum IDDS of 4 and 7, respectively (Ahmed *et al.*, 2019).

The prevalence of complications during pregnancy among women is a serious public health issue. Pregnancy complications among pregnant women in the Jashore district were significantly correlated with women's education level, monthly income, occupation, prenatal health education, and IDD. Additionally, there is a need to increase dietary variety and raise awareness of its nutritional benefits, particularly with regard to pregnancy complications and pregnancy outcomes.

The prime strength of the study was the lack of literature regarding the association between DD and complications during pregnancy. However, due to pregnancy, some respondents were reluctant to give information about some questions. A representative sample of the population was also ensured due to the situation. A larger sample could have been included if funding was available during the study. The food consumption data were collected only once through recall method, which could have been improved if multiple recalls were executed in consecutive weeks.

CONCLUSION

This study demonstrated that a significant portion of pregnant women included in this study who suffered from various pregnancy complications

did not follow the necessary dietary recommendations. Additionally, the DD of pregnant women in the Jashore district was not satisfactory. In this study, it was found that pregnant women residing in the Jashore district mostly consumed a medium-diversified diet. The study also revealed that pregnant women with a low-diversified diet experienced various complications during pregnancy, such as higher prevalences of constipation, preeclampsia, oedema, haemorrhage, visual impairment, and palpitation than those who consumed a high- and medium-diversified diet. The findings of this study highlighted that food diversity, marriage age, and education level, were significantly correlated. Thus, the study concluded that the maintenance of an adequate, diversified diet can help reduce the risk of complications during pregnancy. However, emphasis should also be given to improve the education level of women. Data from this investigation will be used to create guidelines and policies that would make a significant contribution in ensuring pregnant women's DD and minimising pregnancy complications.

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Authors' contributions

Zaman S, conceptualised and designed the study, performed data analysis, wrote and reviewed the paper; Ahammed T, principal investigator, conceptualised and designed the study, analysed and interpreted the data, supervised the entire study, prepared the manuscript, reviewed and edited the paper; Bashar Ma, curated the data and drafted the manuscript.

Conflict of interest

No conflict of interest exists between the authors.

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