

Assessing the Impact of Women's Empowerment on their Nutritional Status in Bangladesh: A Multilevel Logistic Regression Analysis

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Abstract

Women's empowerment is one of the ten 'special initiatives' of Bangladesh government. According to the Global Gender Gap Report 2022, Bangladesh ranks as the most gender-equal nation in South Asia. Understanding how Bangladeshi women are empowering themselves and its impact on their nutritional status is crucial, as the Sustainable Development Goals (SDGs) include both gender equality and women's health. This study aims to investigate women's empowerment in Bangladesh and its impacts on their nutritional status. A total number of 14,862 samples were extracted from Bangladesh Demographic and Health Survey (BDHS) 2017-18 for this study. Women's empowerment was measured using three indicators; (i) women's participation to make decision on their healthcare, (ii) women's participation to purchase household goods and (iii) person who usually decides to visit family and friends. The composite index of these three indicators was used as outcome variable for further statistical analysis. The study revealed that 79.0%, 76.1% and 78.4% women participated to make decision on their healthcare, purchasing household goods and visit to relatives and friends respectively, resulting in 63.7% women being classified as empowered in Bangladesh. Predictors of women's empowerment included: living location (division), type of residence, place of delivery, sex of household head, wealth index, respondents' age, education, occupation, having bank account, total ever born children and decision in using contraception, and beating by husband. After controlling the effect of other factors, it was shown that empowered women were more likely to become over nourished than

unempowered women. The study also found that a strikingly large proportion of women in Bangladesh remained unempowered. Some modifiable factors were found as predictors of women empowerment. Additionally, unempowered women were more likely to be undernourished. These findings can inform Government strategies to address the persistent issues affecting women in Bangladesh.

Keywords: Women empowerment, Nutritional status, SDGs, Logistic regression.

AMS Classification: 91D20, 62P25.

1. Introduction

Women's empowerment is the process through which women gain increased control over their lives and establish their own status. The health and social advancement of the family, community, and nation depend on the empowerment of women (Davis et al., 2014). When women are empowered, they can reach their full potential, contribute effectively to the workforce, and raise healthy, happy children. Achieving the Millennium Development Goals (MDGs) has involved substantial progress towards gender equality, with improved access to the economic and health sectors for women (United Nations, 2015). Many forms of discrimination against women continue to exist in many developing nations (Kibel, 2012).

Bangladesh has made significant improvements in the lives of women and girls over the last 20 years, evidenced by declining mother and child mortality rates and increased gender parity in school enrollment. Despite these advancements, women in Bangladesh continue to be concentrated in low-wage industries, such as the ready-made garments sector, where around 3 million women work under challenging conditions (NIPORT, 2020).

In recent years, Bangladesh has attempted to overcome its backwardness in women's issues while also making significant development in socio-cultural and economic sectors for women (Hossain, 2021). Nevertheless, a significant majority of women still lack the authority to actively engage in a variety of societal spheres, including the political, social, cultural, and economic ones (Evertsen, 2022). The patriarchal and patrilineal social framework in Bangladesh imposes numerous restrictions on women, limiting their access to services and opportunities (Karim et al., 2018). A rigorous division of labor that restricts women's movement, roles, and responsibilities as well as their sexuality is more typically upheld by such a society (Stamarski and Son Hing, 2015). Research indicates that women's and her child's nutritional status was favorably correlated with female empowerment like education, possessions, and engagement in economic sectors (Jones et al., 2020; Galiè et al., 2019; von Salmuth et al., 2021; Al-Sadeeq et al., 2019; Poudel et al., 2022). Numerous studies revealed that improvement of women's educational level and programs aimed at empowering them may therefore play a significant role in lowering the infant mortality rate (Jones et al., 2020; Galiè et al., 2019; Alemayehu et al., 2015).

The Sixth Five-Year Plan (2011-2015) and Vision 2021 aimed to transform Bangladesh into a middle-income country by 2021 (Planning Commission; 2011). Active participation of women in all the spheres, like politics, education, health, economy, agriculture and so on has significantly impacted the development of the country (Walker, 2013). As a result of pro-women measures, Bangladesh ranked 71st globally in terms of political empowerment of women in the Global Gender Gap Report 2022 (GGGR-2022) by the World Economic Forum. According to the same report, Bangladesh ranked first in South Asia, whereas its neighbors India and Pakistan ranked sixth and eighth, respectively (Global Gender Gap Report, 2022). Bangladesh's remarkable strides

towards women's development can be very instructive for other nations, as it is clear that women are contributing more in all areas of society. In addition to successfully implementing the Beijing Platform for Action and Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), the present administration is dedicated to achieving the MDG 2015 of gender equality and empowering women (United Nations, 1995; United Nations General Assembly; 1979).

Despite these achievements, the BDHS 2017–18 reports that 12% of Bangladeshi women are undernourished, with women who have lower wealth index being more likely to be undernourished (Rahman et al., 2022; NIPORT, 2020). A hospital-based study in Bangladesh found that children with better nutrition were born to mothers who were well-nourished, educated, had good childcare knowledge, and had higher family income (Jasmine et al., 2021). The Sustainable Development Goals (SDG) goals are closely linked to maternal and child health. For instance, SDG-3 aims to offer healthy lives for all ages, while SDG-5 aims to empower women with a target level by 2030 (United Nations; 2022).

The objective of this study is to investigate women's empowerment in Bangladesh and its impact on their nutritional status.

Key research questions: The major research questions of this study are: (1) how many married women are empowered in Bangladesh? (2) What are the contributing factors of women's empowerment? (3) Does women's empowerment have any impact on their nutritional status?

We hope the answers of the above questions would help to increase the number of empowered women, and overcome their malnutrition problem.

2. Materials and Methods

Data: This study utilized secondary data from Bangladesh Demographic and Health Survey (BDHS) 2017-18, conducted by the National Institute of Population Research and Training (NIPORT) under the Ministry of Health and Family Welfare. The survey was carried out between October 2017 and March 2018 by the Mitra and Associates, a private research agency. In this survey a total of 20,250 residential households were selected. Each subject in the survey provided information on their socio-demographics, health, and lifestyle. In addition, height and weight was measured of each selected woman. It has been described elsewhere in report about study population, study design, questionnaire, instruments, data collection technique, data reliability etc. of BDHS, 2017-18 survey (NIPORT, 2020).

Sampling: The BDHS-2017-18 survey employed a two-stage stratified sampling method. In the first stage, 675 enumeration areas (EAs), 250 in urban and 425 in rural areas were selected with a probability proportional to EA size. The sample in that stage was drawn by Bangladesh Bureau of Statistics (BBS), following the specifications provided by International Children's Fund (ICF) that include cluster allocation and instructions on sample selection. A complete household listing operation was then carried out in all selected EAs to provide a sampling frame for the second-stage selection of households. In the second stage of sampling, a systematic sample of an average of 30 households per EA was selected to provide statistically reliable estimates of key demographic and health variables for the country as a whole, for urban and rural areas separately, and for each of the eight divisions. Based on this design, 20,250 residential households were selected. Completed interviews were expected from about 20,100 ever-married women age 15-49. The survey was successfully carried out in 672 clusters after elimination of three clusters (one urban and two rural) that were completely eroded by floodwater. These clusters were in Dhaka (one urban cluster),

Rajshahi (one rural cluster), and Rangpur (one rural cluster). A total of 20,160 households were selected for the survey. Any analysis using the 2017-18 BDHS data requires application of sampling weights to ensure the actual representation of the survey results at the national and division levels. The 2017-18 BDHS sampling weights are not expected to lead to any significant differences in the overall survey indicators (NIPORT, 2020). Present author checked the outliers of dataset, and removed the outliers, missing values, incomplete data and pregnant women, finally 14,862 samples were considered for analysis in the present study.

Inclusion and exclusion criteria: The study considered married Bangladeshi women aged 15-49 years. Women who were pregnant at the time of survey, and had missing or incomplete socio-demographic or anthropometric data were excluded (Fig. 1).

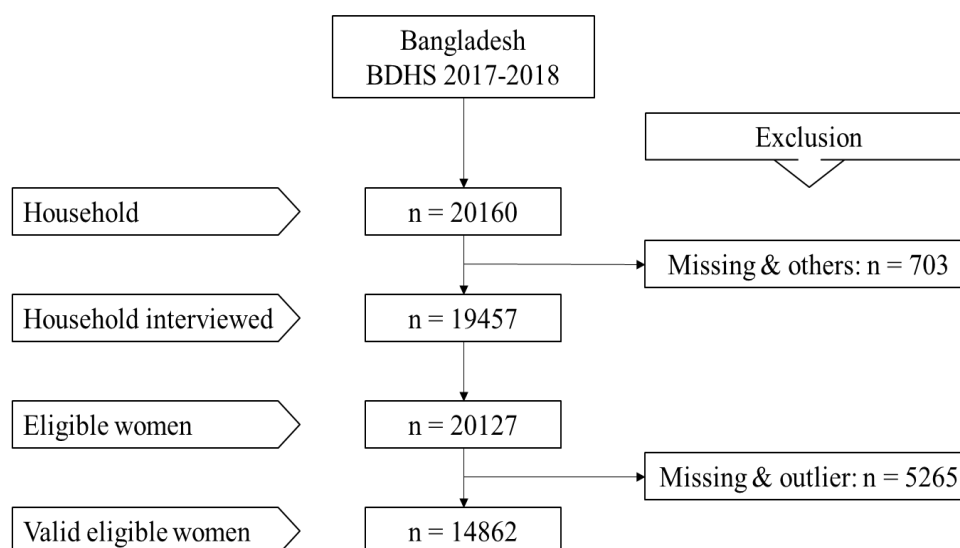


Fig. 1: Procedure for selecting study sample

Outcome variable: The primary outcome variable was women empowerment, measured by the three indicators, such as (a) women's participation in decision making on their own health care, (b) women's participation of purchasing large household goods and (c) women who usually decide to visit relatives and friends. Each indicator was categorical as a nominal measurement with five options, such as respondent alone, respondent and husband, husband alone, someone else, and others. All results were processed as binary variables in accordance with the BDHS criteria, showing "Yes" if the woman had the capacity to make decisions independently or jointly with her husband, and "No" if only the husband or the other family members made the choice. Yes=1 was considered as empowered and No=0 unempowered.

The secondary outcome variable was nutritional status of women, assessed using body mass index (BMI), calculated as $\text{Weight (kg)} / (\text{height (m)})^2$. Women were classified as under nutrition if their $\text{BMI} < 18.5 \text{ kg/m}^2$, normal weight if their $\text{BMI} \geq 18.5$ to < 25 , and over nutrition if their $\text{BMI} \geq 25 \text{ kg/m}^2$.

Independent variable: Some socioeconomic, demographic, household information and anthropometric factors were considered as independent variables in this study. Most of the independent variables were considered on the basis of previous studies as well as the bivariate analysis and were available in BDHS-2017-18 dataset. BDHS-2017-18 collected data from selected sample using a standard household questionnaire. The questionnaires consisted of both structured (pre-coded) and non-structure (open-ended) questions. The selected independent variables were mentioned with their groups and code numbers in Table 1.

Table 1: The list of independent variables with their groups and codes

Variable	Groups	Code	Variable	Groups	Code
Living location (Division)			Educational level		
	Barisal	1		No education	0
	Chittagong	2		Primary	1
	Dhaka	3		Secondary	2
	Khulna	4		Higher	3
	Mymensingh	5	Respondents' occupation		
	Rajshahi	6		Housewife	1
	Rangpur	7		Others	0
	Sylhet	8	Has a bank account		
Type of place of residence				No	0
	Urban	1		Yes	1
	Rural	2	Respondents' body mass index		
Place of delivery				Underweight	1
	Home	1		Normal weight	2
	Others	2		Overweight	3
Sex of household head			Age at first birth (years)		
	Male	1		≤ 20	1
	Female	2		> 20	2
Religion			Age at first cohabitation (years)		
	Muslim	1		≤ 18	1
	Others	2		> 18	2
Wealth index			Total ever born children		
	Poor	1		1 children	1
	Middle	2		2 children	2
	Rich	3		3 children and more	3
Type of toilet facility			Husbands' education level		
	Hygienic	1		No education	0
	Unhygienic	2		Primary	1
Decision in using contraception				Secondary	2
	Respondent jointly	1		Higher	3
	Partner alone	2	Respondents' Age group (years)		
	Others	3		≤ 20	1
Beating justified if argues with husband				21-30	2
	No	0		31-40	3
	Yes	1		41-49	4

3. Statistical Analysis

Frequency distribution was utilized to assess the percentage of women empowerment in Bangladesh. The Chi-square (χ^2) test was used to explore the association between women's empowerment and other categorical variables, and the significantly associated factors were considered as independent variables in logistic model. As we mentioned, BDHS, 2017-2018 collected data from overall Bangladesh using two stages stratified cluster sampling; data came from different levels of hierarchy. There was more probable to have clustering effect of outcome variable. We checked the existence of clustering effect in outcome variable using median odds ratio (MOR) [$MOR = \exp\{0.6745\sqrt{2\sqrt{\delta_u^2}}\} = \exp(0.95\sqrt{\delta_u^2})$], where δ_u^2 is the cluster variance. There is cluster variation of outcome variable if $MOR > 1$ (Larsen and Merlo, 2005). In this study, we got $MOR = 1.87$, it was needed to remove clustering effect of our outcome variable. A single-level statistical model cannot able to remove clustering effect (Khan and Shaw, 2011), need to apply an appropriate statistical model that would remove the effect and provide accurate results. In our present study, two levels of multiple logistic regression model was used to remove the cluster effect of dependent variable, and to determine the impact of our selected factors on women's empowerment in Bangladesh (Islam et al., 2019). The fitness of selected models was tested using Hosmer and Lemeshow test. The model's accuracy was tested by sensitivity, specificity, positive and negative predictive values and receiver operator characteristic (ROC) curve.

Since, women's nutritional status was classified into three categories, multinomial logistic regression model was used to find the impact of women's empowerment on their nutritional status when controlled the effect of other socio-economic, demographic and behavior factors. We used magnitude of the standard error (SE) for detecting the multicollinearity problem among the independent variables, it was judged that there was no evidence of multicollinearity if the SE lies between 0.001 and 0.5 (Chan, 2004). Statistical significance was accepted at $p < 0.05$. Statistical analyses were carried out using STATA (version 13) and SPSS software (version IBM 20).

4. Results

A total number of 14,862 married women aged 15-49 years were included in this study to determine the percentage of women empowerment and its impact on their nutritional status in Bangladesh. It was observed that 79.0%, 76.1% and 78.4% women could take part in decision making on their healthcare, purchasing household goods and visit to their relatives and friends respectively, resulting in an overall empowerment rate of 63.7% (Fig.2).

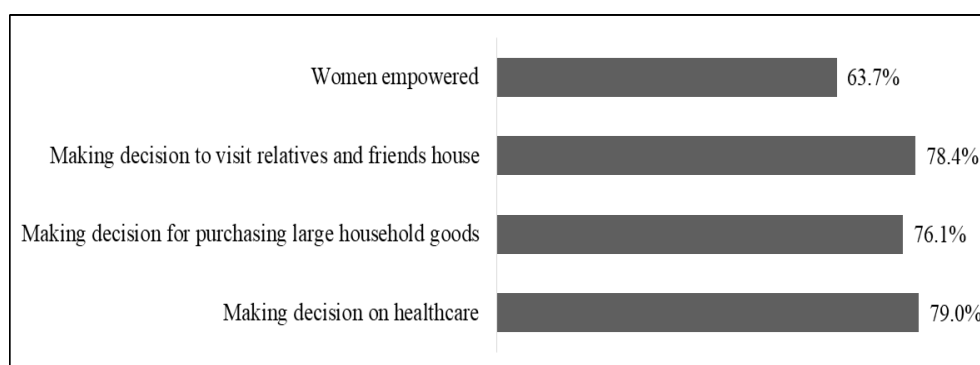


Fig. 2: Frequency distribution of women empowerment

Chi-square test: We observed that all of the selected variables except religion and type of toilet facility were significantly associated with women's empowerment in Bangladesh (Table 2). The significantly associated factors were considered as independent variables in logistic regression model.

Table 2: Summary of the Chi-square test for finding the association between anthropometric measures and socio-economic, demographic factors with women empowerment

Independent variable		Women empowerment	
		Yes, N (%)	No, N (%)
Living location (Division)			
	Barisal	935 (59.4)	639 (40.6)
	Chittagong	1320 (62.4)	797 (37.6)
	Dhaka	1449 (66.5)	731 (33.5)
	Khulna	1278 (64.5)	702 (35.5)
	Mymensingh	1185 (74.1)	414 (25.9)
	Rajshahi	1264 (64.2)	704 (35.8)
	Rangpur	1201 (63.1)	702 (36.9)
	Sylhet	838 (54.4)	703 (45.6)
	χ^2 -value (p value)	155.43 (<0.001)	
Type of place of residence			
	Urban	3726 (68.7)	1699 (31.3)
	Rural	5744 (60.9)	3693 (39.1)
	χ^2 -value (p value)	91.01 (<0.001)	
Place of delivery			
	Home	837 (54.6)	695 (45.4)
	Others	8633 (64.8)	4697 (35.2)
	χ^2 -value (p value)	60.98 (<0.001)	
Sex of household head			
	Male	8203 (62.6)	4904 (37.4)
	Female	1267 (72.2)	488 (27.8)
	χ^2 -value (p value)	61.82 (<0.001)	
Religion			
	Muslim	8500 (63.9)	4812 (36.1)
	Others	970 (62.6)	580 (37.4)
	χ^2 -value (p value)	0.97 (0.436)	
Wealth index			
	Poor	3574 (63.3)	2070 (36.7)
	Middle	1786 (61.5)	1120 (38.5)
	Rich	4110 (65.1)	2202 (34.9)
	χ^2 -value (p value)	12.12 (0.008)	
Type of toilet facility			
	Hygienic	6309 (63.8)	3573 (36.2)
	Unhygienic	3161 (63.5)	1819 (36.5)
	χ^2 -value (p value)	0.20 (0.312)	

Respondents' age group (years)			
	≤ 20	381 (44.4)	477 (55.6)
	21-30	3163 (60.4)	2076 (39.6)
	31-40	3601 (67.9)	1702 (32.1)
	41-49	2325 (67.2)	1137 (32.8)
	χ^2 -value (p value)	221.70 (<0.001)	
Educational level			
	No education	1604 (64.8)	873 (35.2)
	Primary	3220 (64.6)	1767 (35.4)
	Secondary	3453 (61.3)	2184 (38.7)
	Higher	1193 (67.7)	588 (32.3)
	χ^2 -value (p value)	29.85 (0.001)	
Respondents' occupation			
	Housewife	4108 (59.4)	2804 (40.6)
	Others	5359 (67.4)	2587 (32.6)
	χ^2 -value (p value)	102.58 (<0.001)	
Has a bank account			
	No	8042 (62.6)	4807 (37.4)
	Yes	1428 (70.9)	585 (29.1)
	χ^2 -value (p value)	52.49 (<0.001)	
Respondents' body mass index			
	Underweight	1094 (62.3)	662 (37.7)
	Overweight	3541 (66.7)	1767 (33.3)
	Normal	4835 (62.0)	2963 (38.0)
	χ^2 -value (p value)	32.01 (<0.001)	
Age at first birth (years)			
	≤ 20	7625 (62.9)	4492 (37.1)
	> 20	1845 (67.2)	900 (32.8)
	χ^2 -value (p value)	17.78 (0.001)	
Age at first cohabitation (years)			
	≤18	8111 (63.2)	4724 (36.8)
	>18	1359 (67.0)	668 (33.0)
	χ^2 -value (p value)	11.23 (0.003)	
Total ever born children			
	1 children	1852 (56.3)	1440 (43.7)
	2 children	3148 (65.8)	1639 (34.2)
	≥3 children	4470 (65.9)	2313 (34.1)
	χ^2 -value (p value)	101.87 (<0.001)	
Husbands' education level			
	No education	2322 (66.6)	1162 (33.4)
	Primary	2957 (62.3)	1787 (37.7)
	Secondary	2558 (60.7)	1653 (39.3)

	Higher	1633 (67.4)	790 (32.60)
	χ^2 -value (p value)	47.15 (<0.001)	
Decision in using contraception			
	Respondent jointly	6299 (65.8)	3280 (34.2)
	Partner alone	285 (43.8)	366 (56.2)
	Others	2886 (62.3)	1746 (37.70)
	χ^2 -value (p value)	133.21 (<0.001)	
Beating justified if argues with husband			
	No	8259 (64.9)	4485 (35.1)
	Yes	1175 (56.4)	907 (43.6)
	χ^2 -value (p value)	55.56 (<0.001)	

Multilevel logistic regression analysis: SE showed that there was no multicollinearity problem among independent variables. After removing cluster effects, the two levels logistic regression model demonstrated that the women living in Dhaka [AOR=1.42, 95% CI: 1.12-1.79; $p<0.01$], Mymensingh [AOR=2.13, 95% CI: 1.66-2.74; $p<0.001$], and Rajshahi [AOR=1.27, 95% CI: 1.01-1.61; $p<0.05$] divisions were more empowered compared to women living in Barisal division. Women who were living in urban areas were more empowered than the women living in rural areas [AOR=0.62, 95% CI: 0.55-0.71; $p<0.001$]. Women empowerment and delivered at hospital/clinic was positively related [AOR=1.18, 95% CI: 1.04-1.34; $p<0.05$]. In which cases women were the head of the household, they were more empowered [AOR=1.88, 95% CI: 1.66-2.13; $p<0.01$] compared to male household head. Women living in poor family was less likely to have empowered compared to middle [AOR=0.85, 95% CI: 0.77-0.95; $p<0.01$] and rich family [AOR=0.80, 95% CI: 0.72-0.90; $p<0.01$]. Women aged more than 20 years were more likely to become empowered compared to women aged less or equal 20 years [$p<0.01$]. Primary, secondary and higher educated women were more likely to have empowered than uneducated women [$p<0.05$]. Housewife were less likely to become empowered than others [AOR=0.71, 95% CI: 0.65-0.77; $p<0.01$]. Women who had bank account were likely more empowered than who had not [AOR=1.23, 95% CI: 1.09-1.39; $p<0.01$]. Woman who had more than one child was more empowered than women had only one child [$p<0.01$]. Women had power to make decision in using contraception with their partner were likely to be more empowered [$p<0.001$]. Women who were not beat by their husband because of arguing with them indicated that the women were empowered [AOR=0.75, 95% CI: 0.67-0.83; $p<0.01$]. Hosmer and Lemeshow test demonstrated that our model was good fitted ($p>0.05$) (Table 3).

Table 3: Effect of socio-economic, demographic, anthropometric and behavioural factors on women empowerment

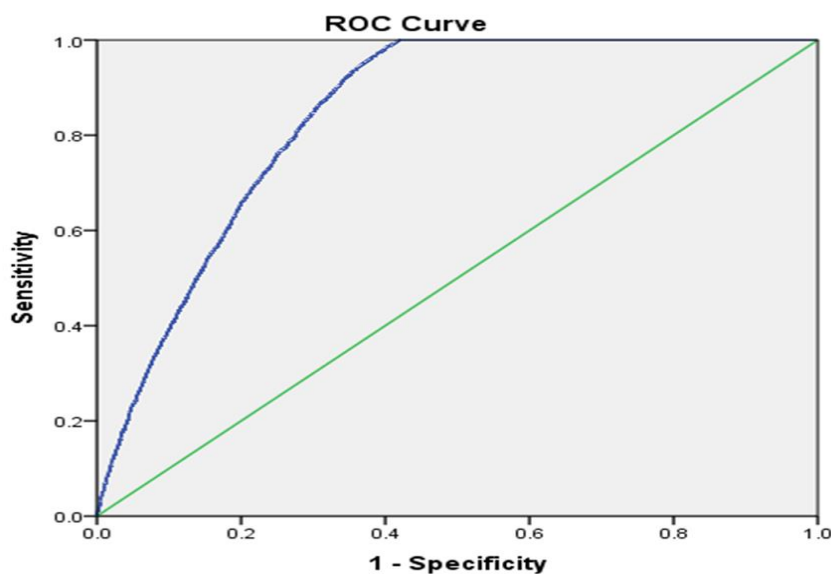
Variables and its categories	AOR	SE	p-value	95% CI for AOR	
				Lower	Upper
Living location (Division)					
Chittagong vs Barisal ®	1.24	0.15	0.069	0.98	1.57
Dhaka vs Barisal ®	1.42	1.70	<0.01	1.12	1.79
Khulna vs Barisal ®	1.26	0.15	0.054	0.99	1.60
Mymensingh vs Barisal ®	2.13	0.27	<0.001	1.66	2.74

Rajshahi vs Barisal ®	1.27	0.15	<0.05	1.01	1.61
Rangpur vs Barisal ®	1.19	0.11	0.156	0.94	1.51
Sylhet vs Barisal ®	0.87	0.11	0.308	0.68	0.13
Type of place of residence					
Rural vs Urban ®	0.62	0.04	<0.001	0.55	0.71
Place of delivery					
Others vs Home ®	1.18	0.08	<0.05	1.04	1.34
Sex of household head					
Female vs Male ®	1.88	0.12	<0.001	1.65	2.13
Wealth index					
Middle vs Poor ®	0.85	0.05	<0.01	0.77	0.95
Rich vs Poor ®	0.80	0.05	<0.001	0.72	0.90
Respondents' Age group (years)					
21-30 vs ≤20®	1.55	0.14	<0.001	1.30	1.84
31-40 vs ≤20®	1.97	0.20	<0.001	1.61	2.41
41-49 vs ≤20®	2.05	0.22	<0.001	1.65	2.55
Educational level					
Primary vs No ®	1.16	0.06	<0.05	1.03	1.30
Secondary vs No ®	1.17	0.08	<0.05	1.02	1.33
Higher vs No ®	1.29	0.12	<0.05	1.06	1.57
Respondents' occupation					
Housewife vs Others ®	0.71	0.03	<0.001	0.65	0.77
Has a bank account					
Yes vs No ®	1.23	0.07	<0.001	1.09	1.39
Respondents' body mass index					
Normal vs Underweight ®	0.95	0.06	0.365	0.84	1.06
Overweight vs Underweight ®	1.07	0.07	0.315	0.94	1.21
Age at first birth (years)					
>20y vs ≤20y ®	0.33	0.07	0.742	0.90	1.16
Age at first cohabitation (years)					
>18y vs ≤18y ®	0.94	0.08	0.348	0.93	1.24
Total ever born children					
2 vs 1 ®	1.26	0.07	<0.001	1.12	1.41
≥3 vs 1 ®	1.21	0.08	<0.01	1.06	1.38
Husbands' education level					
Primary vs No ®	0.90	0.05	0.057	0.81	1.00
Secondary vs No ®	0.82	0.06	0.056	0.72	1.06
Higher vs No ®	0.89	0.07	0.15	0.75	1.04
Decision in using contraception					
Partner vs Respondent jointly ®	0.44	0.04	<0.001	0.36	0.52
Others vs Respondent jointly ®	0.85	0.03	<0.001	0.77	0.92
Beating justified if argues with husband					
No vs Yes ®	0.75	0.04	<0.001	0.67	0.83
Hosmer and Lemeshow Test			Chi-square value = 8.754, p-value = 0.363		

Model justification: The accuracy of our selected model was measured by the area under the ROC curve. The area of this ROC curve was 0.842, the model would assign a higher probability to the subject with being empowered (Fig. 3). The sensitivity was given by $3131/5391=0.872$ (more than 87%), and the specificity is $9461/9467=0.99$ (99%), consequently the positive predictive value (PPV) = $3131/3137 = 99\%$ and the negative predictive value (NPV) = $9461/11721 = 80\%$. It was found that our selected model could correctly detect to empowerment status by about 85% (Table 4).

Table 4: Model discrimination for subject classification

Observed		Predicted		Percentage correct
		Women empowerment		
		No	Yes	
Women empowerment	No	3131	2260	58.1
	Yes	6	9461	99.9
Overall Percentage				84.7



Diagonal segments are produced by ties.

Fig. 3: ROC curve for women empowerment

The association of women empowerment and their nutritional status:

It was found that the prevalence of under nutrition among unempowered women was more than empowered women (12.30% vs 11.60%), while the over nutrition of empowered women was more than underpowered women (37.40% vs 32.80%) (Fig. 4).

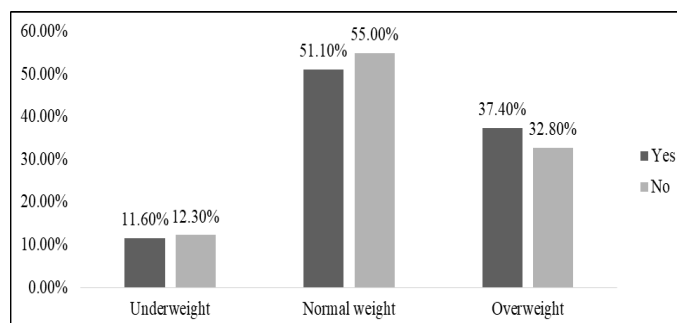


Fig. 4: Nutritional status of Bangladeshi married women by their empowerment (Empowered, Yes; Un Empowered, No)

Multinomial regression analysis: After controlling the effect of socio-economic, demographic and other selected factors, the multiple multinomial logistic model demonstrated that empowered women was more likely to have over nourished compared to unempowered women [AOR= 1.12; CI: 1.00-1.32; $p < 0.01$] (Table 5).

Table 5: Effect of women empowerment on their nutritional status by considering AOR using

Outcome variable (grouped)	OR, 95% CI (Lower-Upper)	AOR, 95% CI (lower-Upper)
Undernutrition vs Normal weight @	0.98 (0.88-1.02)	0.95 (0.85-1.06)
Overnutrition vs Normal weight @	1.118 (0.95-1.128)	1.12(1.008-1.32)*

N. B. Controlling the effect of socio-economic, demographic and behavioral factors. *: 5% level of significance ($p < 0.05$)

5. Discussion

The study aimed to assess the level of women's empowerment in Bangladesh and its impact on their nutritional status. We observed that more than 63% Bangladeshi married women participated in three types of decisions such as their healthcare, major household purchases and visit to relatives and friends house. The women's empowerment rate in Bangladesh has been sharply increasing since 2007 with increasing women education (NIPORT, 2020). It was reported that only 12% of women in Cox's Bazar district, Bangladesh were empowered to decide on their own about seeking healthcare and 8.5% in seeking healthcare for their children, however our study was undertaken countrywide and provided overall findings (Mainuddin et al., 2015; Htun et al., 2021; Mason and Smith, 2003; Kishor, 2000; Jejeebhoy, 2000; Parveen, 2007). They determined women's decision-making power in healthcare by only considering women; however, we determined that 79% of women had the authority to make their own healthcare decisions after taking into account both women and their partners, that's why our percentage was higher. A Myanmar study found that nearly 48% of women encountered social or other impediments to participation in decision-making (Htun et al., 2021).

A multiple measures of married women's empowerment in the domestic sphere in five Asian countries (India, Pakistan, Malaysia, the Philippines and Thailand) was done, the authors suggested that gender relations as heavily influenced by community norms and values, community was a far stronger predictor of women's empowerment than individual traits (Mason and Smith, 2003; Bliznashka et al., 2021). Our study agreed with their findings because this revealed that living location and education of women were important factors associated with women empowerment. It was found in Egypt, women's involvement in household decision-making was

linked to their usage of contraception (Jejeebhoy, 2000). Similar findings in Tamil Nadu, India showed that women with more decision-making authority in the home were more likely to utilize contraception (Parveen, 2007). Our present study also found that women were more likely to feel empowered when they could participate in the decision-making process about using contraception. In a study on the empowerment of rural Bangladeshi women found that the undervaluation of women, the educational gap, the inheritance of property rights, the bias of household heads, violence against women, and the timing of marriage can all contribute to the empowerment of rural women (Bliznashka et al., 2021; Kunto and Bras, 2018). This finding was in line with our study's findings that the aforementioned variables were related to women's empowerment. Studies conducted in Sub-Saharan Africa, Ethiopia, Pakistan and Indonesia indicated that family structure, the husband and wife's education levels, and employment in paid jobs were the main independent determinants affecting women's nutrition and empowerment (Jones et al., 2020; Alemayehu et al., 2015; Kunto and Bras, 2018; Shafiq et al., 2019; Onah, 2021). These findings supported to our findings in the present study.

In present study, we found that empowered women were more likely to get over nutrition compared to unempowered women in Bangladesh. When women become empowered, they can make decisions about their own health care, to be aware of their nutrition and health, to take the required actions to address their health issues, and to ensure a better nutritional status that is appropriate for their health (Mekonnen et al., 2021).

6. Strength and limitation of the study

This was the first time we attempted to investigate women's empowerment and their nutritional status in Bangladesh. In this study, we used nationally representative sample, and selected appropriate all possible statistical techniques and models according to our objectives. However, there were certain limitations to our study. In this study, secondary data was taken into account to determine the rate of women empowerment and their nutritional status. Due to several missing and atypical datasets, we encountered a lot of difficulties, and we were unable to take into account a wide range of additional variables that might be crucial for assessing women's empowerment and how it affects their nutritional condition. It is clear that more research is required regarding women empowerment and their health and nutrition.

7. Conclusions

In the present study, we considered 14,862 Bangladeshi married women aged 15-49 for investigating their empowerment and nutritional status. Data was extracted from the dataset of BDHS-2017-18. Our selected model provided that still a remarkable number (about 37%) of married women in Bangladesh were not empowered, and some modifiable factors were associated with women empowerment. The ability to make decisions is a crucial component of women's empowerment. This analysis clearly suggests that the large-scale nationwide development program is needed to improve the factors which associated with having decision-making power of Bangladesh. The value of women's empowerment with good health will be better understood by society as a whole, especially by women and their families, according to innovative social and behavior change communication tactics that are adapted to the community level.

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MGH, NJE, ASMAM, MAH, RNK, PB. All authors read and approved the final manuscript.

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Availability of data and materials: Supporting data for this study are available in Demographic and Health Surveys (DHS) website and publicly available. All other materials are available from the corresponding author upon request.

Ethics approval and consent to participate: Secondary data from the Demographic and Health Surveys (DHS) was utilized in this study. The ICF Institutional Review Board (IRB), as well as ethical committee of DHS of the host country, have both reviewed and approved the standard of DHS survey procedures and questionnaires. The ICF IRB follows the guidelines laid forth by the US Department of Health and Human Services for the protection of human subjects. Therefore, the data provided by DHS was ethically approved, and its usage did not require any additional ethical approval.

Conflict of interest: The authors declare that they have no competing interests.

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References

- [1] Alemayehu, Y. K., Theall, K., Lemma, W., Hajito, K. W., and Tushune, K. (2015). The Role of Empowerment in the Association between a Woman's Educational Status and Infant Mortality in Ethiopia: Secondary Analysis of Demographic and Health Surveys. *Ethiopian Journal of Health Sciences*, 25(4):353-362. doi: 10.4314/ejhs.v25i4.9.
- [2] Al-Sadeeq, A. H., Bukair, A. Z., and Al-Saqladi, A. M. (2019). Assessment of undernutrition using Composite Index of Anthropometric Failure among children aged <5 years in rural Yemen. *Eastern Mediterranean Health Journal*, 24(12):1119-1126. doi: 10.26719/2018.24.12.1119.
- [3] Bliznashka, L., Udo, I. E., Sudfeld, C. R., Fawzi, W.W., and Yousafzai, A. K. (2021). Associations between women's empowerment and child development, growth, and nurturing care practices in sub-Saharan Africa: A cross-sectional analysis of demographic and health survey data. *PLOS Medicine*, 18(9):e1003781. doi: 10.1371/journal.pmed.1003781.
- [4] Chan, Y. H. (2004). *Biostatistics 202: logistic regression analysis*. Singapore Medical Journal, 45(4):149-153. PMID: 15094982.
- [5] Evertsen, K. F. (2022). The politics of women's lives: gendered re-presentations in Bangladesh's climate change adaptation regime. *Climate and Development*, <https://doi.org/10.1080/17565529.2022.2072264>.
- [6] Galiè, A., Teufel, N., Girard, A. W., Baltenweck, I., Dominguez-Salas, P., Price, M. J., Jones, R., Lukuyu, B., Korir, L., Raskind, I., and Smith, K. (2019). Women's empowerment, food security and nutrition of pastoral communities in Tanzania. *Global Food Security*, 23:125-134. <https://doi.org/10.1016/j.gfs.2019.04.005>.
- [7] Hossain, N. (2021). The SDGs and the Empowerment of Bangladeshi Women. In: *The Palgrave Handbook of Development Cooperation for Achieving the 2030 Agenda: Contested Collaboration*. edn. Edited by Chaturvedi S, Janus H, Klingebiel S, Li X, Mello e Souza Ad, Sidiropoulos E, Wehrmann D. Cham: Springer International Publishing; 2021: 453-474.

- [8] Htun, N. M. M., Hnin, Z. L., and Khaing, W. (2021). Empowerment and health care access barriers among currently married women in Myanmar. *BMC Public Health*, 21(1):139. doi: 10.1186/s12889-021-10181-5.
- [9] Islam, M. A., Mamun, A., Hossain, M. M., Bharati, P., Saw, A., Lestrel, P. E., and Hossain, M. G. (2019). Prevalence and factors associated with early initiation of breastfeeding among Bangladeshi mothers: A nationwide cross-sectional study. *PLoS One*, 14(4): doi: 10.1371/journal.pone.0215733.
- [10] Jasmine, T., Mutanabbi, M., Morshed, J., Rahman, M. M., Islam, M. N., Hossain, M. A., Begum, K., and Aktar, A. (2021). Association between Child Undernutrition and Maternal Undernutrition: A Study in a Tertiary Care Hospital. *Mymensingh Medical Journal*, 30(2):387-394. PMID: 33830118.
- [11] Jejeebhoy, S. (2000). Women's autonomy in rural India: Its dimensions, determinants, and the influence of context. *Women's Empowerment and Demographic Processes: Moving Beyond Cairo*, 204-238.
- [11] Jones, R. E., Haardorfer, R., Ramakrishnan, U., Yount, K. M., Miedema, S. S., Roach, T. D., and Girard, A.W. (2020). Intrinsic and instrumental agency associated with nutritional status of East African women. *Social Science & Medicine*, 247:112803. doi: 10.1016/j.socscimed.2020.112803.
- [12] Karim, R., Lindberg, L., Wamala, S., and Emmelin, M. (2018). Men's Perceptions of Women's Participation in Development Initiatives in Rural Bangladesh. *American Journal of Men's Health*, 12(2):398-410. doi: 10.1177/1557988317735394.
- [13] Khan, M. H. R., and Shaw, J. E. H. (2011). Multilevel logistic regression analysis applied to binary contraceptive prevalence data. *Journal of Data Science*, 9:93-110.
- [14] Kibel, M. (2012). Discrimination against women persists around the globe hampering development. In: *UN Women*. New York; 2012.
- [15] Kishor, S. (2000). Empowerment of Women in Egypt and Links to the Survival and Health of Their Infants. In., edn.; 2000.
- [16] Larsen, K., and Merlo, J. (2005). Appropriate assessment of neighborhood effects on individual health: integrating random and fixed effects in multilevel logistic regression. *American journal of Epidemiology*, 161(1):81-88. <https://doi.org/10.1093/aje/kwi017> PMID: 15615918.
- [17] Kunto, Y.S., and Bras, H. (2018). Women's Empowerment and Gender Inequality in Adolescent Nutritional Status: Evidence from the Indonesian Family Life Survey. *Journal of Biosocial Science*, 50(5):640-665.
- [18] Mainuddin, A., Begum, A. H., Rawal, L. B., Islam, A., and Islam, S. M. (2015). Women Empowerment and Its Relation with Health Seeking Behavior in Bangladesh. *Journal of Family & Reproductive Health*, 9(2):65-73.
- [19] Mason, K. O., and Smith, H. L. (2003). Women's Empowerment and Social Context: Results from Five Asian Countries. In: 2003. Available at https://bpb-us-w2.wpmucdn.com/web.sas.upenn.edu/dist/0/762/files/2020/12/mason_smith-WomensEmpowerment2Jan2003.pdf
- [20] Mekonnen, A. G., Odo, D. B., Nigatu, D., Sav, A., and Abagero, K. K. (2021). Women's empowerment and child growth faltering in Ethiopia: evidence from the Demographic and Health Survey. *BMC Women's Health*, 21(1):42. doi: 10.1186/s12905-021-01183-x.
- [21] Moonzwe Davis, L., Schensul, S. L., Schensul, J. J., Verma, R. K., Nastasi, B. K., and Singh, R. (2014). Women's empowerment and its differential impact on health in low-income communities in Mumbai, India. *Global Public Health*, 9(5):481-494.

- [22] National Institute of Population Research and Training (NIPORT), and ICF. 2020. Bangladesh Demographic and Health Survey 2017-18. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT and ICF.
- [23] Onah, M. N. (2021). Women's empowerment and child nutrition in South-Central Asia; how important is socioeconomic status? *SSM Popul Health*, 13:100718. doi: 10.1016/j.ssmph.2020.100718.
- [24] Parveen, S. (2007). Gender Awareness of Rural Women in Bangladesh. *Journal of international women's studies*, 9:253-269.
- [25] Planning Commission (2011). Sixth Five Year Plan: FY2011-FY2015. In: *Accelerating Growth and Reducing Poverty*. Edited by Planning Mo. Dhaka.
- [26] Poudel, S., Adhikari, C., Yadav, R. K., Yadav, D. K., Thapa, D. K., and Jakovljevic, M. (2022). Disempowered Mothers Have Undernourished Children: How Strong Is the Intrinsic Agency? *Front Public Health*, 10:817717. doi: 10.3389/fpubh.2022.817717.
- [27] Rahman, M., Tariqujjaman, M., Islam, M. R., Sheikh, S. P., Sultana, N., Ahmed, T., Ahmed, S., and Sarma, H. (2022). Socioeconomic Inequalities in Women's Undernutrition: Evidence from Nationally Representative Cross-Sectional Bangladesh Demographic and Health Survey 2017-2018. *International Journal of Environmental Research and Public Health*, 19(8):4698. doi: 10.3390/ijerph19084698.
- [28] Shafiq, A., Hussain, A., Asif, M., Hwang, J., Jameel, A., and Kanwel, S. (2019). The Effect of "Women's Empowerment" on Child Nutritional Status in Pakistan. *International Journal of Environmental Research and Public Health*, 16(22):4499. doi: 10.3390/ijerph16224499.
- [29] Starnski, C., and Son Hing, L. (2015). Gender inequalities in the workplace: the effects of organizational structures, processes, practices, and decision makers' sexism. *Frontiers in Psychology*, 6:1400. doi: 10.3389/fpsyg.2015.01400.
- [30] United Nations (1995). Beijing Declaration and Platform of Action, adopted at the Fourth World Conference on Women. In: *United Nations Specialised Conferences*. Beijing. Available at <https://www.un.org/womenwatch/daw/beijing/pdf/BDPfA%20E.pdf>
- [31] United Nations General Assembly (1979). Convention on the Elimination of All Forms of Discrimination Against Women. In. New York. Available at <https://www.ohchr.org/sites/default/files/Documents/ProfessionalInterest/cedaw.pdf>
- [32] United Nations (2022). The Sustainable Development Goals Report 2022. In. New York. Available at: https://cdn.cdp.net/cdp-production/cms/policy_briefings/documents/000/005/817/original/Final_SDG_Global_Policy_Brief_EN.pdf?1628505514
- [33] United Nations (2015). The Millennium Development Goals Report 2015. In. New York. Available at: [https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20\(July%201\).pdf](https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf)
- [34] von Salmuth, V., Brennan, E., Kerac, M., McGrath, M., Frison, S., and Lelijveld, N. (2021). Maternal-focused interventions to improve infant growth and nutritional status in low-middle income countries: A systematic review of reviews. *PLoS One*, 16(8):e0256188. doi: 10.1371/journal.pone.0256188.
- [35] Walker, N. (2013). Women's Empowerment in Bangladesh: Looking beyond the MDG's. In: *The Daily Star*. 2013.
- [36] World Economic Forum (2022). Global Gender Gap Report 2022. In. Geneva. Available at https://www3.weforum.org/docs/WEF_GGGR_2022.pdf.