Original Research Article

Prevalence of preeclampsia and its associated risk factors in Rajshahi region, Bangladesh

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ABSTRACT

Background: Although preeclampsia claims lives of 70,000 mothers and 500,000 newborns each year, in Bangladesh the comprehensive data-sets are not well-documented. We studied the prevalence of preeclampsia, its trend and the associated risk factors in Rajshahi, Bangladesh.

Methods: Using a cross-sectional longitudinal design, 90 women hospitalized with preeclampsia in 7 hospitals of Rajshahi, Bangladesh were considered in the study, of which Rajshahi medical college hospital (RMCH) is a tertiary referral hospital. The data were collected by interviewing the patients, physical examinations and analyzing patients' pathological profile. For statistical analyses, SPSS software was employed.

Results: During the five years (2013-2017), RMCH admitted pregnant mothers for delivery or with obstructed complications had increased from 11,523 to 17,201, leading to an increase in preeclamptic patients from 407 to 435. Its prevalence rate (3.21%) was found to be decreased linearly with time. The preeclamptic patients were of 16-40 years, averaging 25.90 ± 0.65 years. The youngest (≤20 years) preeclamptic mothers (24%) were at high risk of preeclampsia. The obese (40%) and overweight (29%) preeclamptic mothers experienced severe oedema, headache, vomiting, lower abdominal pain and hyperacidity. About three-fourths of the concerned patients were of lower socio-economic class, of which the majority was below education level 10. The majority were from joint families (58%) who took less than 2.2 L of drinking water per day.

Conclusions: The average prevalence preeclampsia rate was 3.21% that was found to decrease linearly with time. The youngest but obese (BMI of ≥30 kg/m^2) mothers were vulnerable for preeclampsia. Other risk factors include lower socio-economic class, less education, white complexion, joint family type and taking less amount of fluid.

Keywords: Preeclampsia, Prevalence, Bangladesh, Risk factor

INTRODUCTION

Preeclampsia is a multi-system obstetrical disorder of unknown aetiology characterized mainly by development of hypertension ($\geq140/90$ mmHg) with substantial proteinuria (>0.3 g/24 h) and 2+ oedema. According to world health organization's (WHO) systematic review of 129 studies covering approximately 39 million women from 40 countries (2002-2010), the crude incidence of preeclampsia was 2.3%, ranging from 1.2% in the Middle East to 4.2% in the Western Pacific.[1]

Preeclampsia is one of the top five causes of maternal and perinatal mortality worldwide. Preeclampsia claims the

lives of more than 70,000 women and more than 500,000 of their foetuses and newborns each year. This is equivalent to the loss of 1,600 lives per day.[2] About 99% of these losses occur in low-and middle-income countries (LMICs), particularly those on Indian subcontinent and sub-Saharan Africa.[3] For every woman who dies, it is estimated that another 20 suffer a life-altering morbidity.[4] But the origin of preeclampsia remains still elusive. Once preeclampsia is present, there is no definite cure other than to deliver the foetus. Other complications include stroke of brain, placental abruption, cardiovascular disease, HELLP syndrome, premature birth, hemorrhage, etc.[5] Thus preeclampsia is life-threatening to both mother and foetus.

There are numerous risk factors of preeclampsia, such as maternally and paternally derived fatal genes, women who experienced preeclampsia earlier, extremes of maternal ages (≤20 and ≥40 years), overweight or obese as adults, pre-gestational diabetes (type 1 and 2), women with chronic kidney disease and lupus nephropathy, nulliparous women, women who had recurrent spontaneous abortions and infertility treatment and woman having a partner aged >45 years. It is surprising that smoking, although having adverse health effects, during pregnancy approximately halves the risk of preeclampsia.[6-15]

Adu-Bonsaffoh and his co-workers performed a cross-sectional study on the prevalence of various categories of hypertensive disorders in pregnancy (HDP) in Korle Bu teaching hospital (KBTH) of Ghana.[16] They found various types of HDP as 184 (50.0%), 140 (38.0%), 23 (6.3%) and 21 (5.7%) representing gestational hypertension, preeclampsia, chronic hypertension and superimposed preeclampsia respectively. Chun Ye and her co-workers conducted a multicenter cross-sectional retrospective study to estimate the prevalence and analyze the risk factors for HDP among 5,869 pregnant women in China Mainland.[17] They found the highest HDP (7.44%) in northern China and the lowest HDP (1.23%) in central China. They also identified a number of risk factors of HDP including twin pregnancy, age of >35 years, overweight and obesity, primipara, history of hypertension as well as family history of hypertension and diabetes. In Iran, the occurrence of HDP is considerably low compared to the global values or USA (2.32%).[18]

Despite a great deal of research, the origin of preeclampsia is still elusive. To the best of our knowledge, in Bangladesh there is no comprehensive data on the impact of some risk factors of preeclampsia. Since Bangladesh is changing its economic status from lower-middle income country to middle income country, this will definitely affect socio-economic status of the pregnant women, which in turn should influence preeclampsia. In addition, the prevalence of the life-threatening phenomena should be estimated properly. Besides these, relation between placental aetiology of preeclamptic mother and severity of preeclampsia is not well studied in Bangladesh. This reflects the necessity of the present investigation. Therefore, the general objectives of the study were to estimate the prevalence of preeclampsia, its trend with respect to time and to identify the potential risk factors associated with it.

METHODS

Study type and area

The present investigation was mainly a cross-sectional study with some longitudinal studies, in which purposive sampling techniques were followed. The study was performed in 7 hospitals of Rajshahi, North-Western district of Bangladesh, (Figure 1) during 2016-2018. These include RMCH, motherland hospital, Islami bank hospital, Janaseba hospital, Islami bank medical college hospital, Godagari general hospital and Godagari model hospital. of these, the tertiary referral hospital RMCH was the key for the investigation.
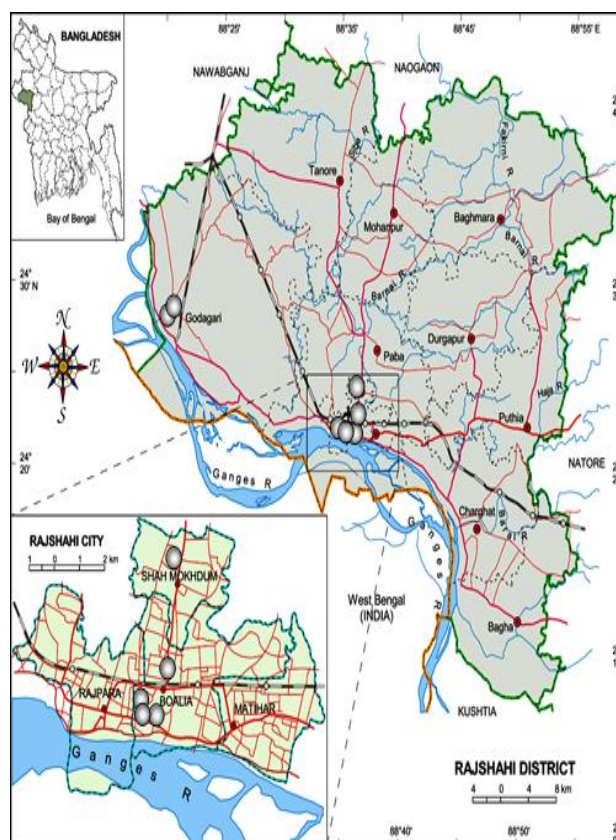

Figure 1: Study area for the investigation (represents study hospital or clinic).

Patient screening techniques

In order to screen the pregnant women (especially ≥20 weeks gestation) for preeclampsia, firstly patient's BP was monitored twice (4 hours apart). If BP was greater than 140/90 mmHg, careful physical observations were made for oedema and other relevant complications (Figure 2). Then the patient's bio-clinical investigation reports were analyzed for elevated levels of proteinuria, serum creatinine and RBC count along with lower level of

platelet count. Above criteria which were in accordance with those of American college of obstetricians and gynecologists confirmed preeclampsia.[19-20]
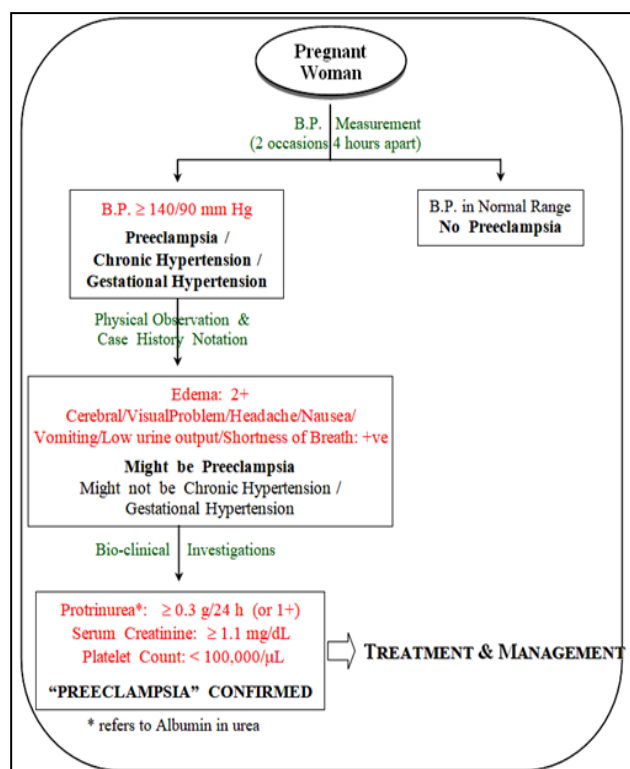

Figure 2: Flow-chart representing the screening of preeclampsia.

Respondent selection and data collection procedure

The sample size (n) was determined based on the model n= Z^2pq/d^2, which was 87. A total of 90 preeclamptic patients visiting OPD or admitted into the hospitals and clinics of age 16-40 were the respondents of this study, of which two-thirds were from RMCH. The data were gathered by interviewing the patients based on developed multi-level questionnaire, by physical examinations and by analyzing patient's pathological profile. The demographic information page contained age, weight and height from which BMI was estimated online.[24] It also contained ethnicity, religion, education, occupation, income level, wealth, living situation, from which SEI (Socio-economic index) was estimated online.[22]

Ethical consideration

The ministry of health and family welfare, the government of the People's Republic of Bangladesh allowed the study to conduct. Moreover, permissions from the authority of concerned Upazilla health complex of Rajshahi district and Rajshahi medical college hospital, Rajshahi were taken for the study. The aim and objectives of the study along with its procedure, risks and benefits of the study were explained properly to the respondents in easily understandable language. When the participants were agreed to cooperate on voluntary basis, their written consents were taken.

Quality control

For recoding patient's BP, average value of both mercury and aneroid sphygmomanometers' readings were considered. Sometimes, it was cross-checked with the reading taken by a highly skilled surgeon. During the interview, sometimes the right answer was collected by side question or discussion. The bio-clinical investigation reports were only accepted when those were performed by highly-skilled pathologists and the instruments were calibrated with r values of 0.998 or better.

Statistical analyses

The datasets obtained were treated separately for analyzing basic statistical parameters and for making cross-tabulations and cross-plots. The SPSS (release 20.0) and Microsoft excel (release 12.0) were employed for the purpose. The ANOVA Table and normal distribution curve were constructed using SPSS.

RESULTS

Prevalence of preeclampsia

Rajshahi medical college hospital being a tertiary referral hospital it keeps the records of the patients properly. We collected 5 year-data (from 2013 to 2017) from RMCH that were sent to ministry of health and family welfare of government of the People's Republic of Bangladesh. Based on the data, we found that the number of pregnant mothers admitted into RMCH for delivery or obstructed complications increased from 11,532 to 17,201 (Table 1). Table 1 reveals that the average number of preeclamptic patients found in RMCH per year is 484 (during the studied 5 years), representing 3.21% of the total pregnant mothers.
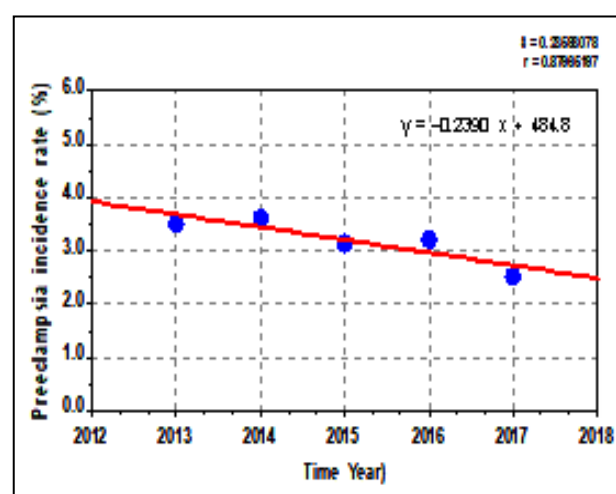

Figure 3: Trend of preeclampsia incidence rate in RMCH with respect to time.

In order to understand the trend of preeclampsia incidence rate with respect to time, Figure 3 is plotted. Obviously, the rate of preeclampsia in pregnant women in Rajshahi region is decreasing in a linear pattern with regard to time. This is perhaps due to increase in consciousness of the pregnant women, government initiatives for free educational policies for females and increase in per capita income. Extrapolation of the trend line reveals that in the years 2024, 2025 and 2026, the preeclampsia incidence rate should be 1.06%, 0.82% and 0.59% respectively. In 2027, our preeclampsia incidence rate should be equal to that (0.4%) of the developed countries, provided that the trend is followed exactly.

Distribution of preeclamptic patients based on age

In this study, the age of the participating preeclamptic patients ranged from 16 to 40 years, with an average of 25.90±0.65 years. The age wise distribution of preeclamptic patients is represented in Figure 4. It is obvious that 69% of the preeclamptic patients were below the age of 29 years. About one-fourth of the preeclamptic mothers were below 20 years, whereas only 1% mother was at 40 years. This reflects that the youngest mothers were at high risk of preeclampsia. The ANOVA (Table 2) shows that the differences in the incidence of preeclampsia among different age groups was found to be statistically significant, ($p<0.05$).
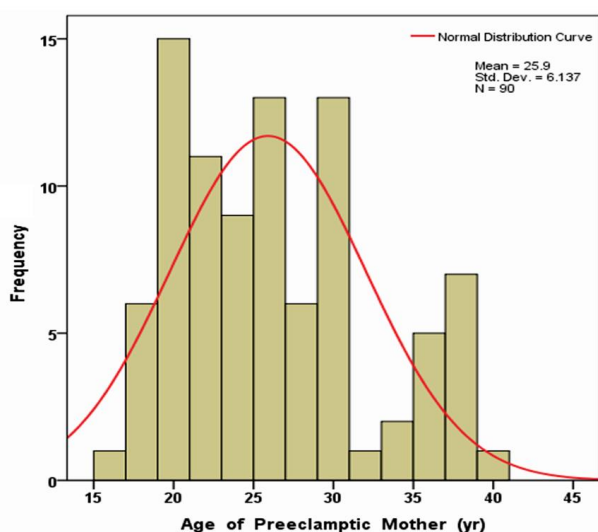

Figure 4: Frequency distribution of ages of the preeclamptic patients.

Distribution of preeclamptic patients based on health type

BMI=Body weight (kg)/ body height (m)^2) is a measure of body fatness. Based upon the BMI values obtained, the preeclamptic patients were classified as: underweight (<18.5), normal (18.5-24.9), overweight (25-29.9) and obese (≥30). The prevalence of preeclamptic patients based on health type within the study period is represented in Figure 5. It was observed that as the patients were more

obese, the occurrence of preeclampsia was increased more. Out of the 90 preeclamptic patients, 36 (40%) were obese, 26 (29%) were overweight, 26 (29%) were also normal and only 2 (2%) underweight. The weight gain of the preeclamptic mothers (n=32) at 40 weeks gestation was also estimated from online pregnancy weight gain calculator.[23] On an average, the gained weight for the pregnant women was 11.3-15.9 kg for normal, 6.8-11.3 kg for overweight and 5.0-9.1 kg for obese mother. It was also found that obese or overweight pregnant preeclamptic mothers were associated with some additional complications such as severe oedema, severe headache, vomiting, lower abdominal pain and hyperacidity.
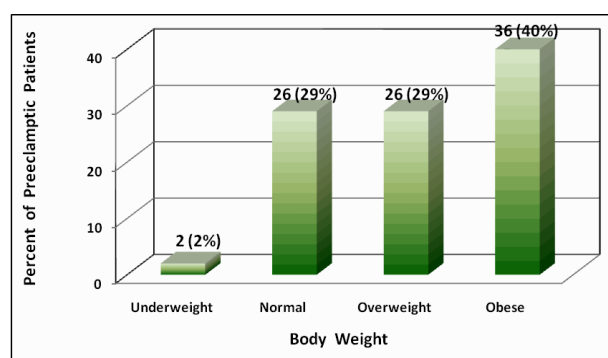

Figure 5: The body weight wise distribution of the preeclamptic patients.

Distribution of preeclamptic patients based on blood groups

It was observed that the studied preeclamptic patients had mainly A+, B+ or O+ blood groups. The percentage rate of preeclampsia based on patients' blood grouping was as follows: A+ (39%) >B+ (33%) >O+ (24%) >AB+ (2%)=O-(2%). It is interesting to note that no preeclamptic patients had A-, B- and AB- blood groups and only 2% patients had very rare O- blood group.
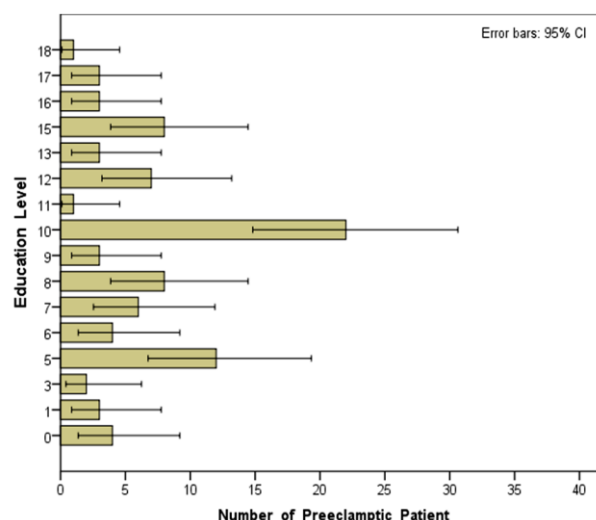

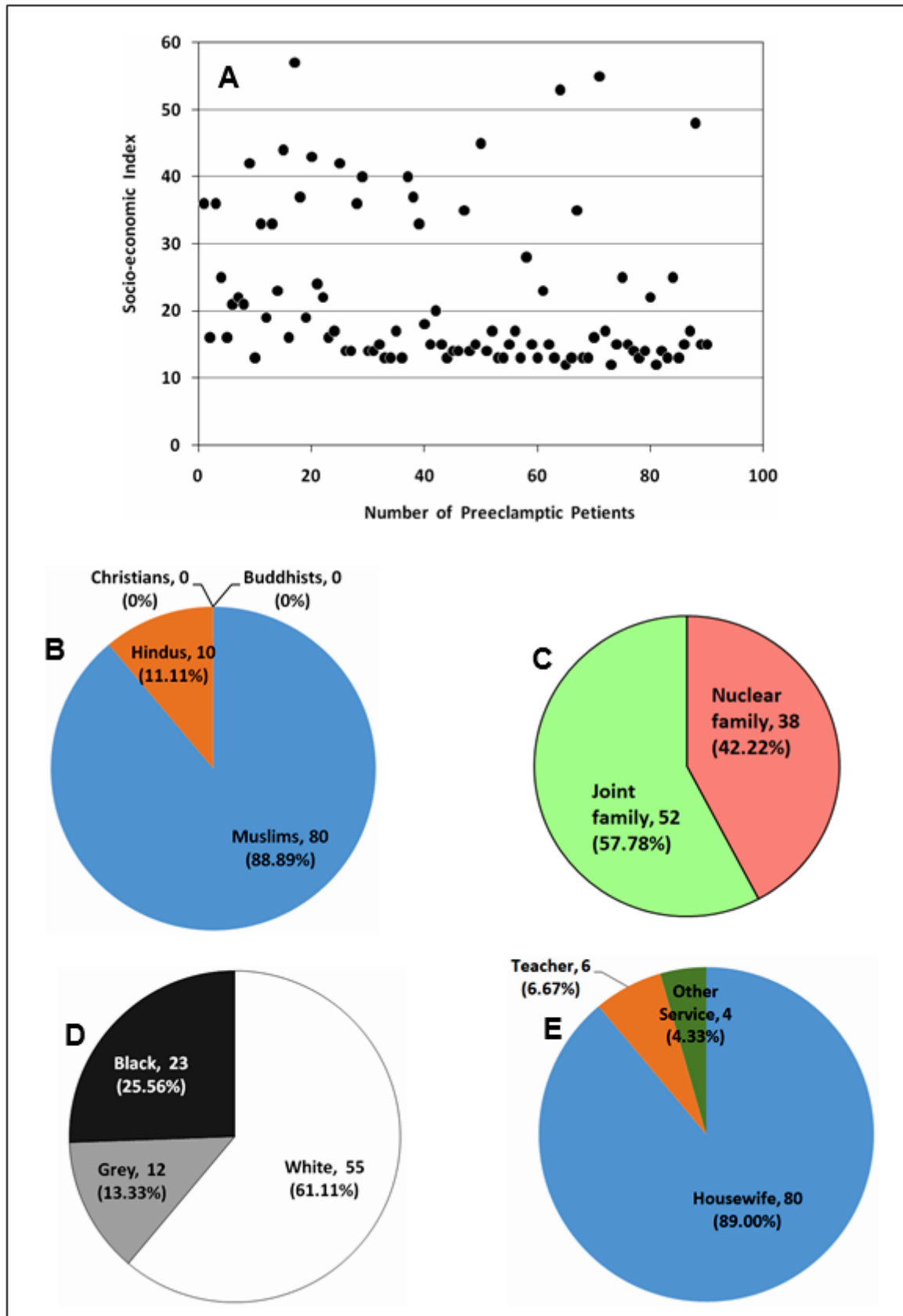**Figure 6: Education level wise distribution of the preeclamptic patients.**

Figure 7: Distribution of preeclamptic patients based on some demographic characteristics. (A) SEI; (B) Religion; (C) Family structure; (D) Color; (E) patients' occupation.

Distribution of preeclamptic patients based on educational levels

It was found that 38.89% (35 in number) of the studied preeclamptic patients completed primary education level, 27.78% (25) were matriculated (education level 10) and 8.89% (8) completed higher secondary education (level 12). The graduate and masters level completed preeclamptic patients were 15.56% (14) and 4.44% (4) respectively. Since 38.89% of the patients were under matriculated and 4.44% (4) were illiterate, they were not very conscious about preventing preeclampsia. The individual education level wise distribution of the patients is represented in Figure 6.

Distribution of preeclamptic patients based on socio-economic indices

SEI is a measure of social class, which was determined from patients' occupation, education, income level and wealth. It was found that out of 90 preeclamptic patients, 69 were within the SEI range of 10-30, whereas 21 were above the range. This means that about three-fourths of the

concerned patients were of lower social class (Figure 7 A). The reasons included that the vulnerable patients were housewife having low income and wealth and were not properly educated.

Distribution of preeclamptic patients based on some demographic characteristics

The 88.89% (80) of the preeclamptic patients were Muslims and 11.11% (10) Hindus with no Christians and Buddhists (Figure 7 B). It was found that 42.22% (38) patients were from nuclear families, whereas 57.78% (52) from joint families (Figure 7 C). Obviously, nuclear family is good for avoiding preeclampsia. Regarding ethnicity all were local women, not migrated, whose skin complexion was 61.11% white, 13.33% grey and 25.56% were black (Figure 7 D).

On the basis of the preeclamptic patients' occupation, 88.89% (80) were housewives, 6.67% (6) were teachers and 4.44% (4) were in other services (Figure 7 E). In other the services, NGO (Non-government) related jobs dominated.

Table 1: Distribution of preeclamptic patients in RMCH from 2013 to 2017.

Distribution	Year					
	2013	2014	2015	2016	2017	Average
Total number of pregnant mothers admitted	11 532	15 119	15 716	16 648	17 201	15 243
Number of preeclamptic patients	407	547	493	538	435	484
Percent of preeclamptic patients	3.53	3.62	3.14	3.23	2.53	3.21

Table 2: ANOVA showing the effect of age on distribution of preeclamptic patients.

Variables	Sum of squares	Df	Mean square	F value	P value
Between age groups	756.286	15	50.419		
Within age groups	2595.814	74	35.079	1.437	<0.05
Total	3352.100	89			

Table 3: Statistical analyses on some demographic data of the preeclamptic patients, (n=90).

Variables	Range	Median	Mean±SE	95% CI for mean	SD	Variance	Skewness	Kurtosis
Age (in years)	16-40	25.00	26.34±0.73	24.88-27.80	5.888	34.665	0.455	-0.575
Body weight (kg)	45-82	62.00	26.34±0.73	61.07-65.53	9.018	81.319	0.237	-0.369
Height (cm)	127-167	152.00	26.34±0.73	150.78-154.21	6.915	47.816	-1.546	3.336
BMI (kg/m^2)	17-38	27.30	26.34±0.73	26.16-28.45	4.610	21.248	0.290	-0.433
Education	0-18	10.00	26.34±0.73	8.31-10.49	4.401	19.369	-0.182	-0.451
Monthly income (Tk)	0-20,000	0.00	26.34±0.73	492-2.185	3,418	1.168×10^7	4.158	18.682
Wealth (Tk)	0-3,000,000	100,000	26.34±0.73	149,930-407,916	520,580	2.710×10^{11}	3.713	15.700
SEI	12-57	15.00	26.34±0.73	19.30-24.98	11.467	131.496	1.283	0.575

Distribution of preeclamptic patients based on food habits

It was found that the pregnant women were conscious about food habits and hence took more proteins, vegetables and fruits. The vegetables and fruits intake rates were above 201.9 and 95.4 gram per capita per day respectively.

This reflects their conciseness and probably acted as one of the factors that inhibit conversion from preeclampsia to eclampsia. But they took less than 2.2 L of drinking water per day, which was important for expanding extra-cellular space and amniotic fluid.

Statistical analysis

Central tendency indicating location of distribution were measured by mean and median; dispersion showing the dissimilarity of values by range, standard deviation and variance; shape of distribution by skewness and confidence interval (95% level) for mean; and tailedness (extreme values in either tail) of distribution by kurtosis. These were analyzed for each demographic dataset of preeclamptic patients using SPSS. ANOVA shows that differences in incidence of preeclampsia among different age groups found to be statistically significant (p<0.05).

DISCUSSION

It was found that 3.21% of total pregnant mothers admitted into RMCH for delivery or with obstructed complications was preeclamptic, which is very close to WHO's report on incidence rate of preeclampsia (2.80%).[24] Pre-eclampsia incidence rates in many Asian countries like India, Pakistan, Nepal, Myanmar, Korea, Bhutan, Iran, Thailand, Indonesia and Malaysia were reported as 2.80%. The same rates were also found in many African countries like Egypt, Ghana, Algeria, Ethiopia, South Africa, Tanzania, Kenya, etc. But in some developed countries like Canada, USA, Australia, Belgium, Denmark, Germany, UK, France, Spain, etc., preeclampsia incidence rates were as low as 0.4%.[24] Our observed preeclampsia incidence rate was slightly higher than the values for the Asian countries. Rate of preeclampsia in pregnant women in Rajshahi region is decreasing in a linear pattern with regard to time.

Our findings of age-wise distribution of preeclampsia are in accordance with many authors. Parra-Pingel and her co-workers found that in Ecuador amongst severe preeclamptic patients, 13.5% were aged 19 or less years and had singleton pregnancies.[25] Kawakita and her researchers found that the prevalence of preeclampsia might be twice as higher in adolescents due to physical immaturity and overlapping maternal growth, nutritional status, socio-economic factors, partner abuse and emotional overload.[26]

A recent meta-analysis concluded that overweight/obesity as well as maternal adiposity is associated with an increased risk of preeclampsia. This risk may be increased two-to three-fold as BMI increases from 21 kg/m^2 to 30 kg/m^2.[27] In the present study, obese preeclamptic patients were found as vulnerable.

In Turkey, it was found that the risk of developing preeclampsia was significantly higher in group AB than other blood groups (p=0.006).[28] The risk of developing hypertension after preeclampsia was significantly higher in group O than other blood groups (p=0.004). This was attributed to an abnormal hemostasis occurred in the uteroplacental circulation of women with preeclampsia, the association between AB blood group and preeclampsia might reflect the multifactorial character of thrombus formation. AB blood group subjects present increased levels of two important hemostatic factors, factor VIII and Von Willebrand factor (VWF), and increased levels of these two hemostatic factors had been related to increased risk for thrombus formation in several conditions.[29]

It was reported that in Iran, the preeclamptic mother's education level was as follows: Illiterate (0%), below high school education (42.3%), high school diploma (20.5%) and university degree (37.2%).[30] Thus the Iranian women's education level was higher than the Bangladeshi women. Saxena and her co-workers found that in Uttar Pradesh (UP) of India, the education level of preeclamptic patients were poor, below Bangladeshi level.[31] They reported illiterate, up to 8th standard, 9th to 10th, 11th to 12th, graduation and post-graduation patients as 40.00%, 32.86%, 5.71%, 11.43%, 7.14% and 2.86% respectively. In the present study the educational levels of the preeclamptic patients are representative of Southern Asia. And it was obvious that low educational attainments were significantly associated with higher risk of the preeclampsia.

Regarding impact of family status, Verma and her co-workers found that in Jaipur of India, there was 1.22 times more risk of preeclampsia in joint families than in nuclear families.

Young children, pregnant and lactating women have increased fluid requirements. Especially pregnant women require additional fluid replacement to ensure that foetal needs are met, as well as providing for expanding extra-cellular space and amniotic fluid. WHO has set the requirement of drinking water for adult female as 2.2 L/day.[32] It was found that on an average 15, 29 and 46 preeclamptic women (comprising 16.67, 32.22 and 51.11% of total) took drinking water above, at and below 2.2 L/day respectively. This means that more than 50% of the women did not fulfil the requirement of drinking water. But most of the women took milk as 200 mL/day, although a few were unable to afford it or were unable to drink it. Please be noted that the amount was not exact, but estimated. According to the patients' statement, they neither smoke nor took alcohol or illicit drug during pregnancy.

Limitations

Since present study was on hypertensive pregnant women experiencing preeclampsia and foetal outcomes, ensuring quality control in each step of data collection was prime concern. It was always remembered that a significant error might be introduced in primary data gathering. But in a very few cases, it was not possible to attain the desired level of maximum accuracy for some instrumental and methodical constrains. Sometimes, the right answer was derived from patients by side question or discussion. In very limited cases, semi-quantitative data was obtained. The concerned hospitals, other than RMCH, were not very efficient to keep the previous records of preeclamptic

patients properly. Keeping the constrains in mind, we carried out the study exercising the maximum precautions.

CONCLUSION

The number of pregnant mothers admitted into RMCH for delivery or obstructed complications was increased from 11,532 to 17,201 during year 2013 to 2017. Consequently, number of preeclamptic patients was also increased from 407 to 435. Average prevalence rate (3.21%) of preeclampsia was found to decrease linearly with respect to time. Age range of the studied 90 preeclamptic patients was 16-40 years, with an average of 25.90±0.65 years. Youngest mothers (≤20 years), representing 24% of total, were at high risk of preeclampsia. Obese or overweight preeclamptic mothers (69%) vulnerable for preeclampsia and were associated with some additional complications including severe oedema, headache, vomiting, lower abdominal pain and hyperacidity. Although A+, B+ and O+ blood grouped preeclamptic patients' dominate, none had A-, B- and AB- blood groups and only 2% had very rare O- blood group. About three-fourths of the patients were of lower socio-economic class, of which 20% was below education level 10 and 4% illiterate. Most of the preeclamptic patients were Muslims (89%) of joint families (58%), serving as housewives (89%), having white skin complexion (61%). They were conscious about food, but took less than 2.2 L of drinking water per day.

ACKNOWLEDGEMENTS

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