To Study the Fetomaternal Outcomes of Pregnancy with Obesity-Retrospective Case-Control Study

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Abstract

Background: Increasing incidence has been seen among women of reproductive age with every one out of five women being affected by obesity. Obesity poses unfavorable outcomes for both mother and child causing ten percent of gestational diabetes and pre-eclampsia, neonatal deaths.

Objective: To find the association of obesity in pregnancy with maternal and perinatal outcomes.The objective is to investigate the association between maternal obesity during pregnancy and various fetomaternal outcomes and outcome of occurrence of cesarean section deliveries, gestational diabetes, preeclampsia, macrosomia, low birth weight babies, and shoulder dystocia among pregnant women with obesity compared to non-obese pregnant women. The study will assess the relative risk and confidence intervals for all the described outcomes.

Subject and Methods: This cohort study was performed in the Department of Obstetrics and Gynaecology, Kulsoom Bai Valika Hospital, site area, Karachi from February to August 2021. A total of 220 patients were included, 110 patients with a BMI equal to or more than 30 kg/m^2 were exposed group and 110 cases BMI less than 30 kg/m^2 were in the non-exposed group. A detailed history and examination, baseline investigations were carried out. Performa was given to patients of each group, and outcomes were recorded.

Results: The average age of the patients was 28.73±6.52 years. The rate of cesarean section and PIH was 3 times more likely in obese groups than non-obese groups [RR=2.74 95%CI: 1.69-3.31] and [RR=3.08 95%CI: 2.11-4.49] respectively. The rate of GDM and preeclampsia was also 2 times more likely in the obese group than the non-obese group [RR=1.48 95%CI: 1.07-2.05] and [RR=2; 95%CI: 1.05-3.79] respectively. The rate of low birth weight was not statistically significant between obese and non-obese groups (p=0.053). While rate of macrosomia 7 times and Shoulder Dystocia time 5 more likely in obese groups than non- obese groups [RR=6.85; 95%CI: 3.24-14.48] and [RR=4.80; 95%CI: 2.56-8.99] respectively.

Conclusion: Obesity is a challenge of the present era for obstetricians, which is reaching the status of epidemic worldwide. This study shows that obesity in pregnant females is directly proportional to poor fetomaternal outcomes, therefore pregnant obese females should be managed as a high-risk case.

Keywords: *Maternal obesity, GDM, preeclampsia, cesarean section, macrosomia, shoulder dystocia.*

INTRODUCTION

Globally, Obesity was classified as a disease in 2013 by the American Medical Association and is a preventable cause of mortality [1-3]. Increasing incidence has been seen among women of reproductive age with every one out of five women being affected by obesity [2-4]. In Pakistan, studies have found obesity to contribute to 24.5%-63.39% [4-6]. According to estimates of a study in 2013. Obesity and overweight females were seen in 60% compared to 34% normal weight females [7].

Obesity during pregnancy contributes to 21.3% of antenatal women being affected which increases the chances of intrapartum, postpartum, and perinatal morbidities and mortalities [8]. Obesity poses unfavorable outcomes for both mother and child causing 10% chances of gestational diabetes and pre-eclampsia, 11% neonatal deaths, and 3 times more chances of hypertension, and diabetes [9, 10]. The study compared obese (BMI 230 kg/m^2) and normal-weight women BMI 20-24.9 kg/m) maternal and perinatal outcomes, found preeclampsia (1.58% *vs.* 0.54%), gestational diabetes (5.02% *vs.* 5.35%), c-section (25.37% *vs.* 10.06%), shoulder dystocia (0.27% *vs.* 0.11%), fetal macrosomia (12.68% *vs.* 5.22%), low birth weight infants (6.29% *vs.* 7.26%) [11].

There are several causes of maternal obesity. Not only does obesity itself increase the risk to maternal health but its associated co-morbidities like diabetes mellitus and hypertension are also the culprits behind poor fetomaternal outcomes. Additionally, obesity, metabolic disease, neuropsychiatric, and cognitive disorders are found prevalent in neonates born to obese mothers [12].

The rationale for the study is to determine the recent magnitude of problems caused by obesity in Pakistan and to encourage multidisciplinary involvement including Nutrition consultation to all overweight or

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obese women, so they can be encouraged to follow a proper lifestyle modification to have a safe pregnancy and better outcome [13]. Pregnant women who have gone through bariatric surgery are prone to nutritional deficiencies, so the need for vitamin supplementation must be evaluated when indicated. Obese patients who need cesarean delivery must be evaluated for need of thromboprophylaxis with heparin to prevent thromboembolism. Anesthetist consultation early in labor should be considered for obese women and weight-reduction specialists' consultation before attempting another pregnancy should be advised.

MATERIALS AND METHODS

This Cohort study with a non-probability consecutive sampling technique was conducted in the Department of Obstetrics and Gynecology, Hospital Karachi, Pakistan from February 2021 to August 2021. The study was approved by the institutional ethics committee approval from the Hospital ethics committee Kulsumbai Valika Social Security SITE Hospital. [Reference no: 0047 / Dated: 10.02.2021]. All patients signed a written informed consent form.

Inclusion criteria were applied (1) age >16- 45 years, (2) All term delivered patients, of any parity, of any mode of delivery, admitted in the inpatient department. (3) Exposed and Non-exposed groups: Patients with a BMI equal to or more than 30kg/m^2 were the exposed group and the non-exposed group was patients with a BMI less than 30 kg/m^2. Exclusion criteria were applied (1) Patients with bleeding disorders. (2) Patients with end-stage renal disease, and liver diseases. (3) Chronic hypertension (4) Type 1 and 2 diabetes.

The sample size was 105 in each group calculated through the WHO sample size calculator by taking a confidence level of 95 % and power of test at 80%.

Operational Definition

Obese and Non-Obese: Obese patients were labelled as patients with a BMI equal to or more than 30kg/m^2, and non-obese patients were labeled as those with a BMI less than 30kg/m^2.

Maternal Outcomes:

1. Gestational Diabetes: was labeled by oral glucose tolerance test with fasting glucose more than 90 mg/dl, after 1 hour more than 186 mg/dl, after 2 hours more than 153 mg/dl, or single RBS more than 140mg/dl, a single reading of FBS more than 100mg/dl.

1. Pre-Eclampsia: it was labeled when a patient was presenting with high blood pressures>140/90mmhg two occasions 4 hours apart and proteinuria (1+ on dipstick).

2. C-Section: means delivery by cesarean section including both elective C-section and emergency C-section.

Perinatal Outcomes:

1. Low Birth Weight: Infants born with a birth weight of less than 2500gm.

2. Macrosomia: it was diagnosed if the delivered baby's weight is more than 4000gms at the time of birth.

3. Shoulder Dystocia: it was defined as vaginal cephalic delivery that requires additional obstetric maneuvers to deliver the fetus after the head has been delivered and gentle traction has failed.

Data Collection Procedure

After approval, the cases fulfilling the inclusion criteria *i.e.*, all term delivered patients, of any party, of any mode of delivery, admitted in Gynae Obs department of KVSS social security SITE hospital, aged between 16 to 45 years, and excluding patients with bleeding disorders, renal or liver disease, chronic hypertension was included. Written patient informed consent was taken from the patient or next of kin by the Researcher's Postgraduate Trainee. Data collection was conducted by investigators. A detailed history and examination, baseline investigations were carried out. BMI was based on height and weight recorded at the first prenatal visit. BMIs were divided into two categories obese (BMI 30.0 kg/m^2 and above) and non-obese (BMI less than 30kg/m^2). Patients were allocated into two groups Obese group will include patients after checking body mass index equal to or greater than 30kg/m^2. While the Non-obese group will include patients with a BMI less than 30kg/m^2. Performance was given to the patient of each group, and outcomes were assessed, gestational diabetes based on an oral glucose tolerance test with fasting glucose more than 90 mg/dl, after 1 hour more than 186 mg/dl, after 2 hours more than 153 mg/dl or single RBS more than 140mg/dl, a single reading of FBS more than 100mg/dl, preeclampsia on basis of high blood pressures>140/90on two occasions 4 hours apart, proteinuria (1+ on dipstick), mode of delivery either SVD, elective c section or emergency c section, Low birth weight infants born with a birth weight of less than 2500gm Macrosomia was diagnosed if fetal weight is more than 4000gms at the time of birth, shoulder dystocia was defined as vaginal cephalic delivery that requires additional obstetric maneuvers to deliver the fetus after the head has delivered and gentle traction has failed.

DATA ANALYSIS

SPSS.20 is used to perform statistical analysis. Mean +/- SD was calculated from the age of the patient, and BMI, gestational age, and parity. Frequency percentage was calculated for the outcome of the study, and pregnancy-induced hypertension, gestational diabetes, birth through C-section, low birth weight, macrosomia, and shoulder dystocia. Maternal and perinatal outcomes were compared between obese and non-obese groups. The Chi-square test was applied, keeping the p-value ≤0.05. Relative risk was calculated, relative risk of more

Table 1: Baseline characteristics of women in exposed and non-obese groups.

Variables	Obese		Non-Obese		Total	
	Mean	SD	Mean	SD	Mean	SD
Age (Years)	29.85	7.91	27.60	4.51	28.73	6.52
Gestation Age (Weeks)	38.11	0.56	38.99	1.57	38.55	1.26
BMI (kg/m2)	31.539	1.05	26.516	1.27	29.02	2.77
Parity	2.25	1.24	2.06	1.83	2.16	1.56

Table 2: Comparison of the rates of Maternal Outcomes in both obese and non-obese groups

Comparison of rate of caesarean section between obese and non-obese groups.					
Cesarean Section	**Obese n(%)**	**Non-Obese n(%)**	**Total n(%)**	**p-value**	**RR [95%CI]**
Yes	71(64.5)	30(27.3)	101(45.9)	<0.001	2.74 [1.69-3.31]
No	39(35.5)	80(72.7)	119(54.1)		
Chi-Square= 30.77					
Comparison of rate of GDM between obese and non-obese groups.					
GDM	**Obese n(%)**	**Non-Obese n(%)**	**Total n(%)**	**p-value**	**RR (95%CI)**
Yes	55(50)	37(33.6)	92(41.8)	0.014	1.48 [1.07-2.05]
No	55(50)	73(66.4)	128(58.2)		
Chi-Square= 6.05					
Comparison of rate of PIH between obese and non-obese groups.					
PIH	**Obese n(%)**	**Non- Obese n(%)**	**Total n(%)**	**p-value**	**RR (95%CI)**
Yes	74(67.3)	24(21.8)	98	0.0005	3.08 [2.11-4.49]
No	36(32.7)	86(78.2)	122		
Chi-Square= 46.02					
Comparison of rate of preeclampsia between obese and non-obese groups.					
Pre-eclampsia	**Obese n(%)**	**Non-Obese n(%)**	**Total n(%)**	**p-value**	**RR (95%CI)**
Yes	24(21.8)	12(10.9)	36(16.4)	0.029	2.00 [1.05-3.79]
No	86(78.2)	98(89.1)	184(83.6)		
Chi-Square= 4.78					
Comparison of rate of low birth weight between obese and non-obese groups.					
Low Birth Weight	**Obese n(%)**	**Non-Obese n(%)**	**Total n(%)**	**p-value**	**RR (95%CI)**
Yes	50(45.5)	36(32.7)	86(39.1)	0.053	1.38 [0.99-1.94]
No	60(54.5)	74(67.3)	134(60.9)		
Chi-Square= 3.74					
Comparison of rate of macrosomia between obese and non-obese groups.					
Macroso-mia	**Obese n(%)**	**Non-Obese n(%)**	**Total n(%)**	**p-value**	**RR (95%CI)**
Yes	48(43.6)	7(6.4)	55(25)	<0.001	6.85 [3.24-14.48]
No	62(56.4)	103(93.6)	165(75)		
Chi-Square= 40.75					
Comparison of rate of shoulder dystocia between obese and non-obese groups.					
Shoulder Dystocia	**Obese n(%)**	**Non-Obese n(%)**	**Total n(%)**	**p-value**	**RR (95%CI)**
Yes	48(43.6)	10(9.1)	58(26.4)	<0.001	4.80 [2.56-8.99]
No	62(56.4)	100(90.9)	162(73.6)		
Chi-Square= 33.81					

*Relative Risk (RR)

than 1 was considered significant. Stratification was done regarding age and gestational age. Post-stratification Chi-square test was applied, keeping p value <0.05. Relative risk was calculated, relative risk of more than 1 was considered significant.

RESULTS

The study included a total of 220 patients with an average age of 28.73±6.52 years. Among them, 110 patients with a BMI equal to or more than 30kg/m^2 were obese group, while 110 cases BMI less than 30 kg/m^2 were in the non-obese group. Table **1** presents the Mean age, gestational age, BMI, and parity according to obese and in-obese groups.

Table **2** displays the rates of maternal outcomes in both obese and non-obese groups. Maternal outcomes such as cesarean section, GDM, PIH, preeclampsia, macrosomia, and shoulder dystocia were significantly associated with the obese group. The rate of cesarean section and PIH was 3 times more likely in obese groups than non-obese groups [RR=2.74 95%CI: 1.69- 3.31] and [RR=3.08 95%CI: 2.11-4.49] respectively. The rate of GDM and preeclampsia was also 2 times more likely in the obese group than the non-obese group [RR=1.48 95%CI: 1.07-2.05] and [RR=2; 95%CI: 1.05-3.79] respectively. The rate of low birth weight was not statistically significant between obese and non-obese groups (p=0.053). While the rate of macrosomia 7 times and Shoulder Dystocia time 5 more likely in obese groups than non-obese groups [RR=6.8595%CI:3.24-14.48] and [RR=4.80;95%CI:2.56-8.99] respectively.

Table **3** presents the rate of poor perinatal outcomes for both groups respectively. Stratification analysis according to age and gestational age was performed. It shows that above 30 years' cesarean section, GDM, pre-eclampsia, and shoulder dystocia rates were higher in the obese group while PIH and low birth weight

Table 3: Comparison the rate of poor Perinatal Outcomes for both obese and non-obese groups

Factors		Groups				p-value	RR [95%CI]
		Obese		Non-Obese			
		Count	%	Count	%		
Comparison of factors between obese and non-obese groups for above 30 years of age.							
Cesarean Section	Yes	13	36.1	5	19.2	0.148	1.87 [0.72-7.79]
	No	23	63.9	21	80.8		REF
GDM	Yes	15	41.7	7	26.9	0.231	1.54 [0.74-3.25]
	No	21	58.3	19	73.1		Ref
PIH	Yes	12	33.3	12	46.2	0.306	0.72 [0.38-1.34]
	No	24	66.7	14	53.8		Ref
Pre-eclampsia	Yes	0	0.0	0	0.0	NA	NA
	No	36	100.0	26	100.0		
Low Birth Weight	Yes	12	33.3	12	46.2	0.306	0.72 [0.38-1.34]
	No	24	66.7	14	53.8		Ref

Factors		Groups				p-value	RR [95%CI]
		Obese		Non-Obese			
		Count	%	Count	%		
Macrosomia	Yes	12	33.3	0	0.0	0.001	NA
	No	24	66.7	26	100.0		
Shoulder Dystocia	Yes	12	33.3	0	0.0	0.001	NA
	No	24	66.7	26	100.0		
Comparison of factors between obese and non-obese groups for below 30 years of AGEnr.							
Cesarean Section	Yes	58	78.4	25	30	<0.001	2.63 [1.85-3.74]
	No	16	21.6	59	70		Ref
GDM	Yes	40	54.1	30	36	0.021	1.51 [1.06-2.16]
	No	34	45.9%	54	64		Ref
PIH	Yes	62	83.8	12	14	<0.001	5.86 [3.44-9.99]
	No	12	16.2	72	86		Ref
Pre-eclampsia	Yes	24	32.4	12	14	0.007	2.27[1.22-4.21]
	No	50	67.6	72	86		Ref
Low Birth Weight	Yes	38	51.4	24	29	0.003	1.79 [1.20-2.69]
	No	36	48.6	60	71		Ref
Macrosomia	Yes	36	48.6	7	8	<0.001	5.84 [2.76-12.32]
	No	38	51.4	77	92		Ref
Shoulder Dystocia	Yes	36	48.6	10	12	<0.001	4.08 [2.18-7.65]
	No	38	51.4	74	88		Ref
Comparison of factors between obese and non-obese groups for below 40-week gestational.							
Cesarean Section	Yes	66	65.3	21	28.4	<0.001	2.30 [1.56-3.39]
	No	35	34.7	53	71.6		Ref
GDM	Yes	51	50.5%	31	41.9	0.260	1.21 [0.86-1.68]
	No	50	49.5	43	58.1		Ref
PIH	Yes	69	68.3	12	16.2	<0.001	4.21[2.46-7.19]
	No	32	31.7	62	83.8		Ref
Pre-eclampsia	Yes	24	23.8	5	6.8	0.003	3.51 [1.41-8.78]
	No	77	76.2	69	93.2		Ref
Low Birth Weight	Yes	50	49.5	19	25.7	0.001	1.93 [1.25-2.98]
	No	51	50.5	55	74.3		Ref
Macrosomia	Yes	43	42.6	7	9.5	<0.001	4.50 [2.15-9.44]
	No	58	57.4	67	90.5		Ref
Shoulder Dystocia	Yes	39	38.6	10	13.5	<0.001	2.85 [1.53-5.34]
	No	62	61.4	64	86.5		Ref
Comparison of factors between obese and non-obese groups for above 40 weeks gestation.							
Cesarean Section	Yes	5	55.6	9	25.0	0.077	2.22 [0.98-5.01]
	No	4	44.4	27	75.0		Ref
GDM	Yes	4	44.4	6	16.7	0.073	2.66 [0.95-7.49]
	No	5	55.6	30	83.3		Ref
PIH	Yes	5	55.6	12	33.3	0.219	1.67 [0.79-3.51]
	No	4	44.4	24	66.7		Ref
Pre-eclampsia	Yes	0	0	7	19.4	0.150	NA
	No	9	100	29	80.6		
Low Birth Weight	Yes	0	0	17	47.2	0.009	NA
	No	9	100	19	52.8		
Macrosomia	Yes	5	55.6	0	0	<0.001	NA
	No	4	44.4	36	100		
Shoulder Dystocia	Yes	9	100	0	0	<0.001	NA
	No	0	0	36	100		

*Relative Risk (RR);
*Not applicable due to zero cell (NA).

were higher in the non-obese group. In the below 30 years group, all the poor outcomes were prevalent in the obese group. The stratification analysis according to gestational age shows that all poor outcomes were more common in the obese group at all gestational ages. Analysis suggests that maternal BMI greater than or equal to 30 kg/m^2 may be a risk factor for adverse maternal and perinatal outcomes.

DISCUSSION

Obesity is globally recognized as a key public health issue, [14, 15] which leads to so many diseases like hypertension, coronary heart disease, type 2 diabetes mellitus, and renal disease which has led to a sharp rise in mortality and morbidity [16, 17].

During pregnancy, obesity increases the risk of fetomaternal complications. Obese women are known to be at risk of antenatal, intrapartum, postpartum, and neonatal complications such as hypertensive disorders of pregnancy, gestational diabetes mellitus, venous thromboembolism, cesarean section, preterm delivery, fetal macrosomia, and unexplained stillbirths [18-25]. Additionally, metabolic disease [26], neuropsychiatric, and cognitive disorders are increasingly found in children of obese women [27].

In the present study, the average age of the patients was 28.73±6.52 years. In Melchor *et al.* study maternal age of normal weight was 33.82±4.86, and in obesity patients age was 34.05±4.94.

In developed countries, obesity has sharply increased in the past 2 decades. WHO has labeled obesity as a major health threat, specifically due to its association with cardiovascular complications [27]. In the latest European Perinatal Health Report, it was found that the prevalence of obesity (BMI ≥ 30 kg/m^2) in pregnant women was least in Poland (7.1%), Slovenia (9.0%), and France (9.9%), while most of the European countries had rates of 12-14%, and in Scotland, the rate of obesity in pregnancy was 20.7% [28].

In this study, maternal and perinatal outcomes like cesarean section, GDM, PIH, preeclampsia, macrosomia, and shoulder dystocia were significantly associated with obese groups as compared to non-obese groups. The

results of a study conducted on singleton pregnancies compared obese (BMI ≥30 kg/m^2) and normal-weight women (BMI 20-24.9 kg/m^2) for maternal and perinatal outcomes, found preeclampsia (1.58% *vs.* 0.54%), gestational diabetes (5.03 *vs.* 5.35%), c section (25.37% *vs.* 10.06%), shoulder dystocia (0.27% *vs.* 0.11%), fetal macrosomia (12.68% *vs.* 5.22%), low birth weight infants (6.29% *vs.* 7.26%) 11.

It is calculated through a systemic review of articles that a rise of 1 kg/m^2 in BMI increases the risk of gestational diabetes mellitus by 0.92%. It was found in another review that the risk of preeclampsia increases to double with each 5-7 kg/m^2 rise in pre-pregnancy BMI [29]. In the Melchor *et al.* study, it was found that maternal obesity increases the rates of hypertensive disorders of pregnancy but not diabetes both pre-gestational and gestational. The specific association of obesity *vs.* gestational diabetes is not clear. Obesity is considered a high risk factor for gestational diabetes whereas the majority of obese women do not develop such disorder [30]. In this study rate of cesarean section and PIH was 3 times more likely in obese groups than in non-obese groups. The rate of GDM and preeclampsia was also 2 times more likely in the obese group than non-obese group respectively. It is calculated through a systemic review of articles that a rise of 1 kg/m^2 in BMI increases the risk of gestational diabetes mellitus by 0.92% [31]. It was found in another review that the risk of preeclampsia increases to double with each 5-7 kg/m^2 rise in pre-pregnancy BMI [31].

In our study, the prevalence of gestational diabetes is much lower in obese women than that found in other studies conducted in North America and Western Europe [29-32], and this could be the rationale behind the absence of differences in the rate of gestational diabetes between obese and normal- weight population. While macrosomia was found 7 times more likely and Shoulder Dystocia 5 times more likely in obese women.

Meta-analysis of data found that a high pre-pregnancy body mass index is linked with infant macrosomia [33]. There is a direct proportionality between maternal obesity and higher birth weight. This study is found to be consistent with the wider literature on obesity in pregnancy and maternal BMI <50 [34]. Similarly, the association between maternal obesity with poor infant condition immediately after birth has been supported by both a wider maternal obesity review [35] and studies of pregnant women with BMI>50 [36].

CONCLUSION

In conclusion, Obesity in pregnancy is increasing worldwide, reaching epidemic proportions in many countries and frequently creating challenges for obstetricians. In this study, our results indicate that maternal obesity is associated with an increased risk of adverse maternal and fetal/neonatal complications. Pregnancy in this population of women should, therefore, be considered and managed as high-risk.

The strength of the study utilizes a robust retrospective case-control design, providing a valuable association between maternal obesity and fetomaternal outcomes. The comprehensive examination of various outcomes including cesarean section rates, gestational diabetes, and preeclampsia, contributes to a holistic understanding of the impact of maternal obesity. The limitation of this study is retrospective nature may be prone to recall bias and limited access to certain data points. External factors such as socioeconomic status and lifestyle choices. Which could influence outcomes, were not extensively explored. Prospective, multicenter studies could validate and expand upon these findings, enhancing their generalizability. Long-term follow-up studies assessing the impact of maternal obesity on the health of offspring could provide valuable insights into intergenerational effects.

A prospective study could involve enrolling pregnant women early in their gestation and regularly monitoring their outcomes, allowing for real-timing data collection and minimizing recall bias. Implementing a multidisciplinary approach involving obstetricians, nutritionists, and mental health professionals can offer comprehensive pre-pregnancy counseling. Addressing lifestyle modifications, nutritional guidance, and mental health support during preconception can potentially reduce the risks associated with maternal obesity, enhancing both maternal and fetal well-being.

ETHICAL APPROVAL

Ethical approval was obtained from the Institutional Ethics Committee of Kulsumbai Valika Social Security (KVSS), SITE Hospital, Karachi (REF letter No. 0047/ Dated: 10-02-2023). All procedures performed in studies involving human participants were following the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT FOR PUBLICATION

Written informed consent was taken from the participants.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

FUNDING

Declared none.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

SS, and SR, participated in the study design, data collection, drafting, and critical review. AM, TRA performed data collection, and analysis and wrote the description of the results. KA and MB participated in data collection and wrote the Discussion. SS, SR, AM, TRA, KA, and MB participated in the finalization of the article. All authors read and approved the final manuscript. All authors read and approved the final manuscript.

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