ORIGINAL ARTICLE

Maternal and Fetal Outcomes in Underweight Pregnant Women

Ahmed A. Ahmed, Ahmed H. Mohammed, Hager A. Khalifa *

Department of Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Assuit, Egypt

Abstract

Background: ***Maternal underweight prior to pregnancy is a well-established risk factor for negative neonatal findings, particularly low birthweight. In a randomized trial from Bangladesh, providing micronutrient and caloric supplementation to women with a low body mass index led to a reduced offspring fatality rate at birth.***

Aim: ***To assess the impact of maternal underweight on the pregnancy outcome on both the mother and the fetus.***

Methods: ***This retrospective cohort research has been performed on 72 underweight pregnant women with clinical criteria of body mass index (BMI) below 18.5 who presented for antenatal care, delivery, abortion, or any other complication of pregnancy.***

Results: ***The mean BMI at admission was 17.6 ± 0.779. Regarding the pregnancy outcome, only 36% of the cases ended with a normal outcome, while 30.6% had PTL, 23.6% ended with abortion, 5.6% with IUFD, and 4.2% with stillbirths. The vast majority of cases had a normal maternal outcome (80.6%). 4.2% of the cases had severe anemia, 2.8% had either PET, PTL, gestational DM, or DM, and 1.4% had either UTI, recurrent infection, or emesis gravidarum. Regarding the fetal outcome, more than half of the cases were normal, while one-fifth of the cases developed fetal morbidity (15 cases) and another-fifth developed fetal mortality (another 15 cases). 38.9% of the study cases needed NICU admission.***

Conclusions: ***Maternal underweight produced adverse outcomes for both the mother and the fetus. Many of the cases ended up with abnormal outcomes such as stillbirth, IUFD, PTL, and abortion. One-fifth of the neonates developed fetal morbidity, and one-fifth developed fetal mortality. About 38.9% of neonates needed ICU admission.***

Keywords: Maternal; Fetal Outcomes; Underweight Pregnant Women

1. Introduction

Maternal underweight prior to pregnancy is a well-established risk factor for negative neonatal findings, particularly low birthweight. In a randomized trial from Bangladesh, providing micronutrient and caloric supplementation to women with a low body mass index led to a reduced offspring fatality rate at birth .[1]

The literature is divided on whether maternal underweight is associated with neutral, increased, or reduced preterm birth (PTB) risks. PTB remains the main reason for neonatal morbidity and mortality, while low birth weight (LBW) is the 2nd most significant condition .[2]

Maternal BMI is associated with negative health outcomes for both the mother and the child, both short-term and long-term. The relationship among maternal underweight, LBW, and PTB may be directly related to a deficiency of nutrients, which results in a shorter gestational period or reduced fetal growth, or indirectly through other factors, like poor diet or medical conditions. It is probable that a greater number of underweight women are in lower socio-economic classes, where they may be engaged in strenuous manual labor or have a genetic or ethnic predisposition to thinness .[3]

A number of systematic reviews and observational studies have established a correlation between negative perinatal results and maternal BMI during pre-pregnancy or early gestation. Low birth weight (LBW) and small for gestational age (SGA) are both linked to pre-pregnancy underweight .[4]

Accepted 19 January 2025.
Available online 31 March 2025

* Corresponding author at: Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Assuit, Egypt.
E-mail address: Smsma.ayman77@gmail.com (H. A. Khalifa).

https://doi.org/10.21608/aimj.2025.446493

2. Patients and methods

This prospective cohort research has been performed on 72 underweight pregnant women aged from 17 to 45 years old, with clinical criteria of BMI below 18.5, who presented for antenatal care, delivery, abortion, or any other complication of pregnancy. This research was performed in Al-Azhar University Hospital and Sohag General Hospital from December 2018 to December 2020. The Ethics Committee of the Faculty of Medicine at Al-Azhar University, Egypt, obtained its approval for the research. All cases provided written informed consent. Exclusion criteria were normal BMI, overweight and obese women, preeclampsia, diabetes mellitus, or other chronic disease that warrants early or immediate delivery, and congenital anomalies in the fetus that may trigger preterm labor (anencephaly, hydrops fetalis).

All patients were subjected to: A detailed history, Demographic data collection (weight, height, and calculation of BMI), and antenatal laboratory investigations [random blood sugar (RBS), complete blood count (CBC), and urine analysis].

At admission, BMI, parity (0, 1, 2, 3, 4, 5, 6, and 7), number of abortions, and gestational age were recorded.

The body mass index of the patient was identified using the following: BMI = weight/height2 (kg/m2) through the initial case consult. According to these body mass index findings, cases have been categorized into 3 categories depending on World Health Organization (WHO) criteria: 25.0–29.9 kg/m2 (overweight), 18.5–24.9 kg/m2 (normal), and < 18.5 kg/m2 (underweight), and we included underweight pregnant women.

At birth, the weight of the neonate was determined on a scale and rounded to the nearest 50 grams. Measurements were taken on a measuring mat and rounded to the nearest centimeter for neonatal birth length. The gestational age was expressed in completed weeks, calculated based on the most recent menstruation, and adjusted for the United States finding in the event of a variance exceeding one week. Pregnancy outcome (Normal, abortion, Preterm Labor (PTL, IUFD, and Stillbirth), maternal outcome (normal, anemia, UTI, recurrent infection, PTL, gestational DM, DM, and emesis gravidarum), and fetal outcome (normal, fetal morbidity, and fetal mortality) were documented. All neonates admitted to the NICU were recorded.

Statistical analysis

SPSS v26 (IBM Inc., Chicago, IL, USA) was utilized to conduct the statistical analysis. The mean and standard deviation (SD) of quantitative variables were presented. Frequency and percentage (%) were utilized for expressing qualitative variables.

3. Results

The mean age of the study population was 28 years, ranging from 17 to 42 years. The mean age of the study cases was 27.3 years, with a wide range from 6 to 40 weeks at time of first visit. Nearly half of the cases had parity of 1-3 deliveries before the current pregnancy, while 26% were primipara, and the remaining cases had parity of 4 or more deliveries before the current pregnancy. Regarding abortion, only one third of the cases (including the 26% of primipara cases) had no history of previous abortions, while more than half of the cases had either 1 or 2 previous abortions and around 12% had 3 or more previous abortions. The vast majority of cases had no pre-pregnancy diseases (79.2%). The most common disease was PTL (seen in 11.1% of the cases) followed by PET (2.8%) and then one case had each of UTI, DM, Gestational DM, IUFD, stillbirth. The mean height of the study population was 164 cm, with a range from 150 to 178 cm. The mean weight before pregnancy was 48 Kg, which was increased to 56.2 Kg at admission. The mean BMI at admission was 17.6, with a range from 14.3 to 18.4. Table 1

Table 1. case characteristics of the study population

Age (years)			28.06 ± 7.097	
Gestational age at admission			27.29 ± 11.695	
Parity			1.96	2.31±
Living			1.68±1.34	
Abortion			1.21±1.24	
Pre diseases			No	Percent
	Non		57	79.2
	PTL		8	11.1
	PET		2	2.8
	UTI		1	1.4
	DM		1	1.4
	Gestational DM		1	1.4
	IUFD		1	1.4
	Stillbirth		1	1.4
	Total		72	100.0
	Height	Weight before pregnancy	Weight at admission	BMI
Mean	164.11	48.08	56.22	17.608
Median	164.00	48.00	58.00	17.900
Std. Deviation	6.719	5.084	8.755	0.779
Minimum	150	38	37	14.3
Maximum	178	60	69	18.4

Regarding the pregnancy outcome, only 36% of the cases ended with normal outcome, while 30.6% had PTL, 23.6% ended with abortion, 5.6% with IUFD and 4.2% with stillbirths. The vast majority of cases had normal maternal outcome (80.6%). 4.2% of the cases had severe anemia, 2.8% had either PET, PTL, gestational DM or DM and 1.4% had either UTI, recurrent infection or emesis gravidarum. Regarding the fetal outcome, more than half of the cases were normal, while one fifth of the cases developed fetal morbidity (15 cases) and another fifth developed fetal mortality

(another 15 cases). 38.9% of the studies cases needed NICU admission. Table 2

Table 2. Pregnancy outcome, maternal outcome, fetal outcome and the need for neonatal intensive care unit (nicu) admission of the study population

		No	Percent
Pregnancy outcome	Normal	26	36.1
	Abortion	17	23.6
	PTL	22	30.6
	IUFD	4	5.6
	Stillbirth	3	4.2
	Total	72	100.0
Maternal outcome	Normal	58	80.6
	Anemia	3	4.2
	UTI	1	1.4
	Recurrent infection	1	1.4
	PET	2	2.8
	PTL	2	2.8
	Gestational DM	2	2.8
	DM	2	2.8
	Emesis gravidarum	1	1.4
	Total	72	100.0
Fetal outcome	Normal	42	58.3
	Fetal morbidity	15	20.8
	Fetal mortality	15	20.8
	Total	72	100.0
NICU admission	Yes	28	38.9
	Total	72	100.0

The vast majority of cases had anemia, manifested by the mean HB level of 10.5 gm/dL and the range of HB which was between 7.3 gm/dL (severe anemia) and 12.2 gm/dL (just normal). On the other hand, the RBS ranged from 65 mg/dL (hypoglycemia) to 360 mg/dL (uncontrolled diabetes), with a mean of 133.7 mg/dL and a very wide standard deviation of 50 mg/dL. Urine analysis was normal in most of the cases (61%), showed only urate salts in 27.8%, urates with pus in 4.2%. Urinary tract infection was seen in 5.6% of the cases and frank glucose was found in 1.4% of the cases (only one case). Table 3

Table 3. Hemoglobin, random blood sugar levels and Urine analysis of the study population

Hemoglobin and random blood sugar levels		
	Hb	RBS
Mean	10.499	133.71
Median	10.700	130.00
Std. Deviation	1.002	50.407
Minimum	7.3	65
Maximum	12.2	360
Urine analysis		
	No	Percent
Normal	44	61.1
Urate	20	27.8
Urate + Pus	3	4.2
Glucose	1	1.4
UTI	4	5.6
Total	72	100.0

4. Discussion

Despite the global obesity epidemic, many pregnant women remain underweight. A BMI < 18.5 kg/m2 is regarded as maternal underweight at the start of pregnancy .[6]

Malnutrition is more prevalent in low- and middle-income nations worldwide. For instance, in the majority of Sub-Saharan African nations, over thirty percent of females of reproductive age are underweight. BMI is influenced by genetic, social, cultural, and body image variables, making underweight females a diverse group .[7] Large cohort data sets, however, have shown that underweight pregnant females tend to be much younger, unmarried, educated, and unemployed. Additionally, there is research that suggests smoking is more common among underweight women .[8]

Being underweight prior to pregnancy was strongly linked with ethnicity in an American cohort study3. The study questions the reliability of body mass index as a gauge of wellness across a multi-ethnic population, citing a differential of maternal underweight of 8.6 percent in the Asian population and 1.9 percent in the Black American population .[6]

Although being underweight can protect against a number of prenatal and intrapartum issues, it is linked to unfavorable outcomes for both the mother and the foetus, such as low birthweight and preterm birth. In spite of this, there is still a dearth of evidence-based recommendations for these women's best treatment. Females with a body mass index < 18.5 kg/m2 are expressly excluded from the National Institute for Health and Care Excellence's (NICE) weight management advice before, during, and after pregnancy .[6]

As a result of the mother's higher metabolic demands during pregnancy, maternal nutritional status is regarded to be significant for foetal growth. The Dutch Famine Cohort Study12 shown that pregnancies during times of scarcity increase the number of LBW infants (2500 g) .[9].

The rise in the prevalence of low-birthweight newborns and late preterm (34–37 weeks of gestation) is the effect of low maternal BMI that has been most frequently documented in the literature.[10] Han et al.[11] examined data from more than one million pregnancies in industrialized and developing nations in a sizable systematic analysis that was published in 2011. The developed and developing nations had an increase in LBW that was statistically significant (RR 1.48, 95% CI 1.29-1.68; and RR 1.52, 95% CI 1.25-1.85, respectively). It's interesting to see that only developed nations had a statistically significant link with premature birth. Given that poor nations account for the majority of preterm births and the majority of early infant mortality, this could have worldwide implications.

Our study showed that nearly half of the cases had parity of 1-3 deliveries before the current pregnancy, while 26% were Primipara, and the remaining cases had parity of 4 or more deliveries before the current pregnancy. Regarding abortion, only one third of the cases (including the 26% of primipara cases) had no history of previous abortions, while more than half of the cases had either 1 or 2 previous abortions, and around 12%

had 3 or more previous abortions. Tang et al.[12] showed that regarding the history of underweight pregnant women, 0.2 % had preterm labor, 2.4 % had miscarriage, 9.5 % had a history of induced abortion, 0.6 % had a history of stillbirth, 0.2 % had a history of birth defect, and 16.2 % had a history of Primipara.

Our study showed that the average gestational age of the study cases was 27.3 weeks, with a wide range from 6 to 40 weeks at the time of first visit. Wahabi et al.[13] reported that the average gestational age at delivery was 38.37. Tang et al. [12] reported that the average gestational age at delivery was 39.0 ± 1.4.

Our study showed that regarding the pregnancy outcome, only 36% of the cases ended with a normal outcome, while 30.6% had PTL, 23.6% ended with abortion, 5.6% with IUFD, and 4.2% with stillbirths.

Wahabi et al.[13] reported that 89.7 % had full-term birth, 10.2 % had preterm birth, 0.6 % had stillbirth, and 3.8 % had intrauterine growth restriction.

Tang et al.[12] reported that 5.2 % had preterm birth and 0.9% had stillbirth.

Our study showed that many cases had no pre-pregnancy diseases (79.2%). The most common disease was PTL (seen in 11.1% of the cases), followed by PET (2.8%), and then one case had each of UTI, DM, Gestational DM, IUFD, and stillbirth.

Our study reported that many cases had anemia, manifested by the mean HB level of 10.5 gm/dL and the range of HB, which was between 7.3 gm/dL (severe anemia) and 12.2 gm/dL (just normal). On the other hand, the RBS ranged from 65 mg/dL (hypoglycemia) to 360 mg/dL (uncontrolled diabetes), with a mean of 133.7 mg/dL and a very wide standard deviation of 50 mg/dL. Wahabi et al.[13] reported that no woman had preexisting diabetes; however, 13.5 % had gestational diabetes. This study reported that 20.2 % had passive tobacco smoke exposure, no preexisting hypertension, 46.5 % were primiparous, 42 % multiparous (1-4), and 11.5 % grand multiparous (>4 deliveries)

Our study showed that the vast majority of cases had normal maternal outcome (80.6%). 4.2% of the cases had severe anemia, 2.8% had either PET, PTL, gestational DM or DM and 1.4% had either UTI, recurrent infection or emesis gravidarum.

Wahabi et al.[13] reported that 89.7 % had full-term birth, 10.2 % had preterm birth, 0.6 % had stillbirth, 13.5% had gestational diabetes, and 3.8 % had intrauterine growth restriction.

Geraldin et al.[14] reported that 79 out of 300 participants developed anemia, and 64 of these (81%) were classified as underweight. Of the 49 cases that had a preterm delivery, approximately 37 (75.5%) were classified as underweight by their BMI.

Liang et al.[15] showed that pre-pregnancy underweight females were at risk for LBW, preterm delivery, as well as gestational weight gain below the IOM guidelines compared to females of normal weight. The study observed that females with lower maternal body mass index at delivery were more prevalent in the pre-pregnancy underweight group, leading to a greater fetal body weight/maternal BMI in the BMI ≤ 18.5 group.

Regarding the fetal outcome, more than half of the cases were normal, while one-fifth of the cases developed fetal morbidity (15 cases) and another-fifth developed fetal mortality (another 15 cases). Wahabi et al.[13] reported no mortality in neonates of underweight pregnant women. The study reported low birth weight in 23.6% of neonates and 0.6 % with macrosomia.

Our study showed that 38.9% of the neonates needed NICU admission. Geraldin et al.[14] reported that in 39 cases, the baby was born with intrauterine growth retardation. Out of the 39 cases, approximately 25 (64.1%) were classified as underweight by the BMI. 41 (73.2%) neonates were born to mothers with underweight BMI, while 56 necessitated intensive care unit (NICU) admission. Limitations: the findings were obtained from a single center, and they may not be applicable in other locations. A control group was not included in comparison with the study group. No association or correlation was done, so relationships were not adequately measured.

4. Conclusion

Maternal underweight produced adverse outcomes for both the mother and the fetus. Many of the cases ended up with abnormal outcomes such as stillbirth, IUFD, PTL, and abortion. One-fifth of the neonates developed fetal morbidity, and one-fifth developed fetal mortality. About 38.9% of neonates needed ICU admission.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

Funding

No Funds : Yes

Conflicts of interest

There are no conflicts of interest.

References

1. Domanski G, Lange AE, Ittermann T, Fallenberg J, Allenberg H, Zygmunt M, et al. Maternal pre-pregnancy underweight as a risk factor for the offspring: Survey of Neonates in Pomerania. Acta Paediatr. 2021;110:1452-60.
2. Branum AM, Schoendorf KC. Changing patterns of low birthweight and preterm birth in the United States, 1981-98. Paediatr Perinat Epidemiol. 2002;16:8-15.
3. McDonald SD, Han Z, Mulla S, Beyene J. Overweight and obesity in mothers and risk of preterm birth and low birth weight infants: systematic review and meta-analyses. Bmj. 2010;341:28- 66.
4. Trojner Bregar A, Blickstein I, Bržan Šimenc G, Janša V, Verdenik I, Lučovnik M, et al. Perinatal advantages and disadvantages of being underweight before pregnancy: A population-based study. Gynecol Obstet Invest. 2017;82:303-6.
5. Cai J, Liu L, Zhang J, Qiu H, Jiang X, Li P, et al. Low body mass index compromises live birth rate in fresh transfer in vitro fertilization cycles: a retrospective study in a Chinese population. Fertil Steril. 2017;107:422-9.
6. Burnie R, Golob E, Clarke S. Pregnancy in underweight women: implications, management and outcomes. J Obstet Gynaecol. 2022;24:50-7.
7. Denison FC, Norwood P, Bhattacharya S, Duffy A, Mahmood T, Morris C, et al. Association between maternal body mass index during pregnancy, short-term morbidity, and increased health service costs: a population-based study. Bjog. 2014;121:72-81.
8. Ehrenberg HM, Dierker L, Milluzzi C, Mercer BM. Low maternal weight, failure to thrive in pregnancy, and adverse pregnancy outcomes. Am J Obstet Gynecol. 2003;189:1726-30.
9. Bhaskaran K, Dos-Santos-Silva I, Leon DA, Douglas IJ, Smeeth L. Association of BMI with overall and cause-specific mortality: a population-based cohort study of 3·6 million adults in the UK. Lancet Diabetes Endocrinol. 2018;6:944-53.
10. Robillard PY, Dekker G, Boukerrou M, Le Moullec N, Hulsey TC. Relationship between pre-pregnancy maternal BMI and optimal weight gain in singleton pregnancies. Heliyon. 2018;4:6-15.
11. Han Z, Mulla S, Beyene J, Liao G, McDonald SD. Maternal underweight and the risk of preterm birth and low birth weight: a systematic review and meta-analyses. Int J Epidemiol. 2011;40:65-101.
12. Tang J, Zhu X, Chen Y, Huang D, Tiemeier H, Chen R, et al. Association of maternal pre-pregnancy low or increased body mass index with adverse pregnancy outcomes. Sci Rep. 2021;11:38-1.
13. Wahabi H, Esmaeil S, Fayed A. Maternal prepregnancy weight and pregnancy outcomes in saudi women: Subgroup analysis from riyadh mother and baby cohort study (rahma). Biomed Res Int. 2021;2021:59-42.
14. Monteiro G, Anupama N, Kini RD, Nayanatara AK, Shetty S, Vinodini NA, et al. Effect of maternal underweight on fetal outcome. Biomedicine (India). 2019;39:480-3.
15. Liang C-C, Chao M, Chang S-D, Chiu SY-H. Impact of prepregnancy body mass index on pregnancy outcomes, incidence of urinary incontinence and quality of life during pregnancy - An observational cohort study. Biomed J. 2020;43:476-83.