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Effect of Exercise During The 3rd Trimester of Pregnancy on Mode of Delivery and Perinatal Outcomes: A Prospective Study

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ABSTRACT

Background: Women from underprivileged backgrounds typically have poor delivery outcomes, including low birthweight (LBW), and frequently participate in strenuous physical labor at home and on farms. Research conducted in Kenya found that even during pregnancy, many women exercised for 78% of the day. Given that Ethiopia has one of the highest rates of LBW, it is likely that a comparable level of activity is also present there. High-income nations have established standards about the required amount of physical activity for expectant mothers in each trimester of pregnancy due to the extensive documentation of the relationship between birthweight and physical activity levels throughout pregnancy.

Objective: To examine the type and level of maternal physical activities and other characteristics during the third trimester and their association with the mode of delivery and prenatal outcomes.

Patients and Methods: A total of 200 women were recruited to identify the effect of exercise during the 3rd trimester of pregnancy on mode of delivery and perinatal outcomes. 20 women were excluded from the study (8 patients declined consent and 12 patients did not meet the inclusion criteria), and 180 women were enrolled in a retrospective study at the Obstetrics and Gynecology Department, Faculty of Medicine, Menoufia University Sers El Lian General Hospital, during the period from April 2022 to October 2023.

Results: Neonatal birth weight was significantly increased among exposed patients (2.88±0.30) than non-exposed patients (2.10±0.00), (P<0.001). Also, weight in the first and third trimesters were significantly higher among exposed patients (69.58±6.97, 73.47±4.35) than non-exposed (68.40±0.41, 69.10±4.03), (P=0.034, 0.001) respectively. Moreover, there was a significant difference among the studied groups regarding mode of delivery, gravidity, and parity (P<0.05), mode of delivery as cesarean section was found in 81.25% of non-exposed patients and in 29.27% of exposed patients (P=0.020). Also, parity as 1–2 children was found in 100.0% of non-exposed patients and in 62.20% of exposed patients (P<0.001).

Conclusion: Women who are living in rural area were exposed to high physical activity. Our study showed that women who weren't exposed to physical activity had risk to born babies with LBW. 83.33% of women with mild physical activity were delivered by caesarean section. While in moderate physical activity all women delivered by caesarean section.

Keywords: LBW, Pregnant physical activity, Neonatal, 3rd trimester of pregnancy, Mode of delivery.

INTRODUCTION

The primary measure of newborn health and the main focus of infant health policy is still birthweight. In the majority of low-income nations, newborns with low birthweights are more likely to die and suffer from illnesses. Globally, low birthweight (LBW) remains a major public health concern, with low- and middle-income countries (LMICs) having the highest prevalence [(1)].

Over 91% of LBW newborns are born in LMICs, according to the United Nations Children's Fund, which also recorded a global LBW prevalence of 14.6%. It is a significant public health issue that affects a child's survival, physical development, psychological growth, and overall health and nutritional condition. In the first month of life, it is one of the most important indicators of infant mortality [(2)]. Chronic conditions such as high blood pressure, diabetes, coronary heart disease, and renal insufficiency are linked to LBW later in life [(3,4)].

Countries and regions differ in the frequency of LBW, with Southeast Asia and sub-Saharan Africa bearing a disproportionately high burden [(5)]. According to the **Hassan *et al.*** [(1)] research, the incidence of LBW in Egypt was 32.4%, significantly higher than the 13% predicted by the Egypt Demographic Health Survey [(6)].

In addition to maternal characteristics, the main causes of LBW are intrauterine growth restriction and preterm delivery, or a combination of the two, suggesting multiple etiologies. Risk factors for LBW include socioeconomic characteristics such adverse socioeconomic circumstances, domicile, age at pregnancy, mother education, and employment [(7)].

The likelihood of LBW is significantly increased by physical and behavioral factors, such as low maternal weight at conception, short maternal stature, maternal comorbidities, lack of prenatal care or insufficient prenatal care, an unfavorable reproductive history, birth order and interval, multiple pregnancies, and illicit drug use [(8)].

Reducing newborn mortality to at least 12 per 1,000 live births by 2030 was the objective of the sustainable development goal. Similarly, by 2025, the Global Nutrition Target sought to reduce by 30% the number of babies born weighing less than 2,500 grams.

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Finding the risk variables associated with LBW is essential to creating a focused intervention as part of the LBW reduction plan [(9)].

Women from low-income areas typically have poor delivery outcomes, including LBW, and frequently participate in strenuous physical activities at home and on farms [(10)]. A research conducted in Kenya found that many pregnant women spend 78% of their daytime hours exercising. It is likely that Ethiopia, which has one of the highest rates of LBW, has a comparable level of physical activity. High-income nations have produced guidelines on the appropriate amount of physical activity for pregnant women in each trimester of pregnancy due to the extensive documentation of the relationship between birthweight and physical activity levels throughout pregnancy [(11)].

This study aimed to examine the type and level of maternal physical activities and other characteristics during the third trimester and their association with the mode of delivery and prenatal outcomes.

PATIENTS AND METHODS

Study design and patient criteria

A prospective cohort study was conducted on 200 pregnant women at the Obstetrics and Gynecology Department, Faculty of Medicine, Menoufia University and Obstetrics and Gynecology Department, Sers El Lian General Hospital during the period April 2022 to October 2023.

Patients' criteria:

In this study, we included pregnant women in their 3rd trimester (31-34 weeks of gestation). Patients having diabetes mellitus, hypertension, previous preterm baby, liver or kidney diseases, and patients with psychological disturbance or any form of chronic pain before or during pregnancy were excluded from the present study.

Sample size:

The sample size was computed using PASS 11.0 and based on **Legesse *et al.*'s**[(9)] previous analysis of the literature, assuming an estimated LBW prevalence of 9.8% among women in the unexposed group; a 15% difference between the exposed and unexposed groups; 80% power; and a 95% level of confidence. The ultimate sample size was 200 pregnant women, with a 10% non-response rate.

All pregnant women were subjected to the following:

- **Sociodemographic characteristics obtaining** (name, age, residence, ethnicity, formal education, husbands' formal education, water source, and wealth quintile).
- **Obstetric and behavioral characteristics** (gravity, parity, history of miscarriage, birth interval, antenatal care, iron folic acid supplement, maternal height, maternal mid-upper arm circumference, pre-pregnancy weight, gestational weight gain).
- **Food types and consumption frequency:** the food consumption frequency of pregnant women was obtained.
- **Physical activity level and incidence of LBW.**

Ethical consideration:

Prior to the start of the trial, each patient completed a written informed consent form outlining its purpose. The Menoufia University Hospital's Ethical Scientific Committee approved the study plan. The study adhered to the Helsinki Declaration throughout its execution.

Statistical analysis:

On a personal computer, Microsoft Excel 2019 and SPSS version 25.0 were used to tabulate and statistically assess the results. The data were described using frequency and percentage for qualitative data and mean ± SD for quantitative data. When comparing the groups on a single qualitative variable, the X^2-test was utilized. When comparing two groups with respect to regularly distributed (parametric) quantitative data, the standard student-t test (t) was employed; statistical significance was established at $p < 0.05$.

RESULTS

A flowchart of the study population is shown in figure 1. Of the 200 recruited women, 20 women were excluded from the study (8 patients declined consent and 12 patients did not meet the inclusion criteria, 180 women were willing to participate and divided into two groups, the non-exposed group (n=16) and the exposed group (n=164).

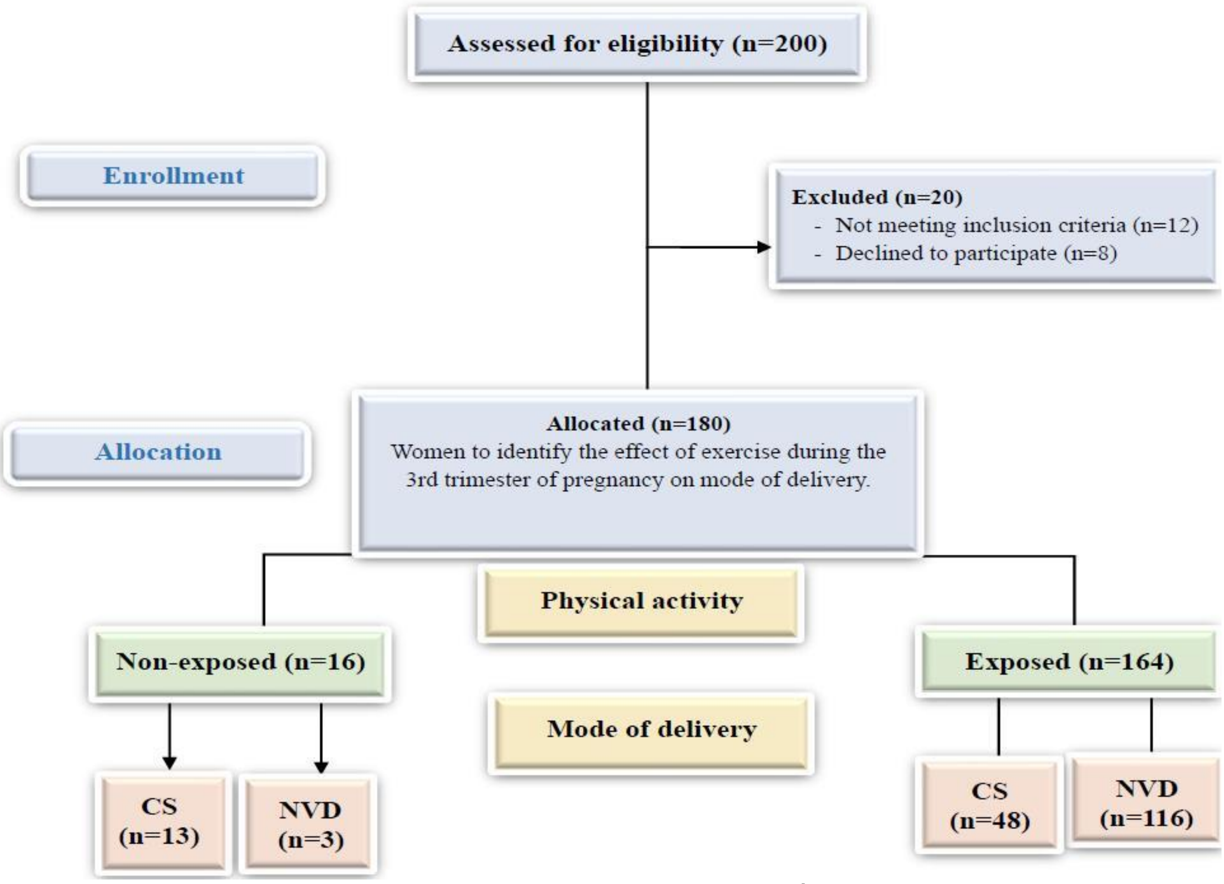

Fig. (1): Flowchart of women to identify the effect of exercise during the 3rd trimester of pregnancy on mode of delivery.

Maternal age was significantly increased among exposed patients than non-exposed patients. Also, residence as city was recorded in 100.0% of non-exposed patients and 37.80% of exposed patients, and rural area was recorded in 62.20% of exposed patients with significant differences among the studied groups. While there wasn't significant difference among the studied groups regarding occupation (Table 1).

Table (1): Sociodemographic characteristics among the studied groups (n=180).

Variable	Non-exposed group (n=16)		Exposed group (n=164)		X^2	P-value
	N	%	N	%		
Maternal age (years)						
Mean± SD	29.50±0.52		31.81±1.66		t=5.527	**<0.001***
Range	29.00-30.00		28.00-34.00			
Occupation						
Non	16	100.00	133	81.10	3.654	0.056
Employee	0	0.00	31	18.90		
Residence						
City	16	100.00	62	37.80	22.964	**<0.001***
Rural area	0	0.00	102	62.20		

X^2: Chi-square test, **t:** Independent t-test, ***:** Significant.

There was a significant difference among the studied groups regarding gestational age, height, pregnancy BMI, maternal weight gain, mode of delivery, gravidity, and medical history. However, neonatal birthweight was significantly increased among exposed patients than non-exposed patients. Also, weight in the first and third trimesters was significantly higher among exposed patients than non-exposed. Moreover, regarding mode of delivery, cesarean section was significantly more frequent in non-exposed patients than in exposed patients. Also, parity as 1–2 children, was found in 100.0% of non-exposed patients and 62.20% of exposed patients with significant difference (Table 2).

Table (2): Obstetric and some physical characteristics among the studied groups (n=180).

Variable	Non-exposed group (n=16)		Exposed group (n=164)		t	P-value
	N	%	N	%		
GA (weeks) Mean± SD Range	38.00±0.00 38.00-0.00		38.11±1.49 34.00-40.00		0.943	0.347
Neonatal birthweight (Kg) Mean± SD Range	2.10±0.00 2.10-0.00		2.88±0.30 2.40-3.50		33.074	**<0.001***
Height (cm) Mean± SD Range	1.62±0.02 1.60-1.63		1.63±0.03 1.58-1.70		1.209	0.063
Pregnancy BMI (kg/m^2) Mean± SD Range	24.55±2.32 22.30-26.80		23.59±1.67 20.20-26.50		1.612	0.126
Maternal weight gain (Kg) Mean± SD Range	12.25±2.32 10.00-14.50		12.23±2.07 9.10-15.80		0.030	0.976
Weight first trimester (Kg) Mean± SD Range	68.40±0.41 68.00-68.80		69.58±6.97 55.84-80.30		2.137	**0.034***
Weight third trimester (Kg) Mean± SD Range	69.10±4.03 65.20-73.00		73.47±4.35 64.22-79.48		4.114	**0.001***
Mode of delivery NVD CS	 3 13	 18.75 81.25	 116 48	 70.73 29.27	**X^2**=6.386	**0.012***
Gravidity Primigravida Multigravida	 5 11	 31.25 68.75	 24 140	 14.63 85.37	**X^2**=8.702	**0.007***
Parity P0 1–2 children More than or equal 3 children	 0 16 0	 0.00 100.00 0.00	 16 102 46	 9.76 62.20 28.05	**X^2**=18.532	**<0.001***
Miscarriage None One Two	 8 8 0	 50.00 50.00 0.00	 126 15 23	 76.83 9.15 14.02	X^2=3.695	0.068
Medical history Negative Free Preterm labor PET	 0 16 0 0	 0.00 100.00 0.00 0.00	 16 132 8 8	 9.76 80.49 4.88 4.88	**X^2**=3.797	0.284

GA: Gestational age, **BMI:** Body mass index, **CS:** Cesarean section, **NVD:** Normal vaginal delivery, **PET:** pre-eclamptic toxaemia, **t:** inpendendant t-test, **X^2:** Chi square test, ***:** Significant.

Incidence of low birth weight was significantly higher in non-exposed patients than exposed patients (Table 3). Mild and moderate physical activity was significantly more in patients under normal vaginal delivery than in patients under cesarean section. Also, low birth weight was found in 14.75% of patients under cesarean section and in 6.72% of patients under normal vaginal delivery with significant relation among the studied groups (Table 4).

Table (3): Incidence of low birthweight among the studied groups (n=180).

Variable		Non-exposed group (n=16)		Exposed group (n=164)		X^2	P-value
		N	%	N	%		
Low birth weight	No Yes	7 9	43.75 56.27	156 8	95.12 4.88	44.983	**<0.001***

X^2: Chi-square, ***:** Significant.

Table (4): Physical activity level and incidence of low birth weight concerning mode of delivery (n=180).

Variable	Mode of delivery				X^2	P-value
	CS (n=61)		NVD (n=119)			
	N	%	N	%		
Physical activity						
No	4	6.56	7	5.88	7.727	**0.015***
Normal	21	34.43	25	21.01		
Mild	31	50.82	63	54.62		
Moderate	5	8.20	22	18.49		
Low birth weight						
No	52	85.25	111	93.28	17.629	**0.002***
Yes	9	14.75	8	6.72		

NVD: Normal vaginal delivery, **CS**: caesarean section, **X^2:** Chi-square test, *****: Significant.

Mild physical activity was found in 55.21% of patients without LBW and in 23.53% of patients with LBW, with a significant relation among the studied groups (Table 5). Also, maternal age was significantly decreased among patients with LBW than patients without LBW. Regarding occupation, non-employees were frequent in patients without LBW than in patients with LBW with a significant relation. Also, residence as a rural area was recorded in more patients without LBW than in patients with LBW (Table 6).

Table (5): Physical activity level about LBW (n=180).

Variable	LBW				X^2	P-value
	No (n=163)		Yes (n=17)			
	N	%	N	%		
Physical activity						
No	5	3.07	8	47.06	44.800	**<0.001***
Normal	43	26.38	3	17.65		
Mild	90	55.21	4	23.53		
Moderate	25	15.34	2	11.76		

X^2: Chi square test, *****: Significant

Table (6): Sociodemographic characteristics in relation to LBW (n=180).

Variable	Low birth weight				X^2	P-value
	No (n=163)		Yes (n=17)			
	N	%	N	%		
Maternal age/year Mean± SD	32.01±1.45		29.00±0.83		t=14.582	**<0.001***
Occupation						
Non	136	83.44	13	76.47	5.761	**0.016***
Employee	27	16.56	4	23.53		
Residence						
Urban	66	40.49	12	70.59	36.213	**<0.001***
Rural	97	59.51	5	29.41		

X^2: Chi-square test, *****: Significant.

There wasn't significant relation among LBW groups regarding gestational age and pregnancy BMI. While neonatal birth weight, height, and maternal weight gain were significantly increased among patients without LBW than patients with LBW. Also, weight in the first and third trimesters were significantly increased among patients without LBW than patients with LBW. Multigravida, parity as 1–2 children, non-miscarriage, and free medical history were found more in patients without LBW than in patients with LBW (Table 7).

Table (7): Obstetric and behavioral characteristics in relation to LBW (n=180).

Variable	Low birth weight				t	P-value
	No (n=163)		Yes (n=17)			
	Mean± SD		Mean± SD			
GA (weeks)	38.06±1.51		38.33±0.48		1.725	0.087
Neonatal birthweight (Kg)	2.90±0.29		2.20±0.14		18.800	**<0.001***
Height (m)	1.63±0.03		1.60±0.02		5.820	**<0.001***
Pre-pregnancy BMI (kg/m^2)	23.76±1.52		23.10±2.81		1.132	0.268
Maternal weight gain (Kg)	12.39±1.99		11.20±2.41		2.303	**0.029***
Weight first trimester (Kg)	70.29±6.39		64.21±6.06		4.540	**<0.001***
Weight third trimester (Kg)	73.95±3.91		67.47±4.01		7.382	**<0.001***
Gravidity						
Primigravida	16	10.26	8	33.33	**X^2**=9.586	**0.002***
Multigravida	140	89.74	16	66.67		
Parity						
P0	8	5.13	8	33.33		
1–2 children	102	65.38	15	62.50	**X^2**=32.219	**<0.001***
More than or equal 3 children	46	29.49	1	4.17		
Miscarriage						
None	118	75.64	16	66.67		
One	15	9.62	8	33.33	**X^2**=12.921	**0.002***
Two	23	14.74	0	0.00		
Medical history						
Negative	8	5.13	8	33.33		
Free	132	84.62	16	66.67	**X^2**=21.892	**<0.001***
Preterm labor	8	5.13	0	0.00		
PET	8	5.13	0	0.00		

GA: Gestational age, **BMI:** Body mass index, **PET:** pre-eclamptic toxaemia, **t:** inpendendant t-text, **X^2:** Chi-square, ***:** Significant.

DISCUSSION

The issue of LBW remains a major public health concern [(2)]. Chronic conditions such high blood pressure, diabetes, coronary heart disease, and renal insufficiency were linked to LBW later in life. Countries and regions differ in the frequency of LBW, with Southeast Asia and sub-Saharan Africa bearing a disproportionately high burden [(12)]. The likelihood of LBW is significantly increased by physical and behavioral factors, such as low maternal weight at conception, short maternal stature, maternal comorbidities, lack of prenatal care or insufficient prenatal care, an unfavorable reproductive history, birth order and interval, multiple pregnancies, and illicit drug use [(13)]. Women from low-income areas typically have poor delivery outcomes, including LBW, and frequently participate in strenuous physical activities at home and on farms [(9)].

In our study, maternal age was significantly increased among exposed patients than non-exposed patients. Also, residence, as the city was recorded in 100.0% of non-exposed patients and 37.80% of exposed patients, and rural areas, were recorded in 62.20% of exposed patients with a significant difference among the studied groups. Similarly, **Legesse *et al.*'s study** [(9)] revealed that the average age of the participants was 29.1±5.4. The majority of them (71.1%) lived in rural areas. Our findings closely matched those of a research conducted by **Hassan *et al.*** [(1)], which found that the participants' ages varied from 18 to 43. Of the participants, 17.3% were from rural regions. The percentage of working moms among the participants was just 15.9%.

In our study, neonatal birth weight was significantly increased among exposed patients than non-exposed patients. Moreover, there was a significant difference among the studied groups regarding mode of delivery, parity, and miscarriage, mode of delivery as the cesarean section was found in all non-exposed patients and 70.73% of exposed patients. Also, parity as 1–2 children was found in 100.0% of non-exposed patients and 62.20% of exposed patients. Also, miscarriage at one time was found in 50.0% of non-exposed patients and 9.15% of exposed patients. According to research by **Ruchat *et al.*** [(14)], **Jukic *et al.*** [(15)] **and Pathirathna *et al.*** [(16)], there is no discernible link between birthweight and intense physical activity. Since these studies evaluated the benefits of scheduled physical exercise alone—that is, two to three times per week for little more than an hour—these results should be regarded with caution. Our results are consistent with those of **McCowan *et al.*** [(17)] who reported that daily vigorous physical activity is linked to an increased risk of LBW. In contrast, **Legesse *et al.*** [(9)] observed that the incidence of LBW was greater among mothers who engaged in vigorous activities. A 19.8-gram decrease in birthweight was also documented by **Bisson *et al.*** [18] for every additional metabolic equivalent of task (MET)/hours/week of intense exercise.

Furthermore, according to **Meander *et al.*** [19], 27.3% of the individuals who were included said they had attained the necessary level of physical activity. Higher levels of physical activity were linked to lower gestational weight increase, a lower chance of emergency cesarean sections, better self-rated health throughout pregnancy, and a lower risk of going above the Institute of Medicine's guidelines for gestational weight gain. During pregnancy, higher levels of sedentary time were linked to worse self-rated health. Interestingly, only one of these studies offered sufficient details of the exercises to qualify as vigorous-intensity exercise. Two additional reviews also reported reduced birthweight without an SGA diagnosis [20,21].

The current study showed that LBW was found in all non-exposed patients and 4.88% of exposed patients with significant differences among the studied groups. Recent research by **Xi *et al.*** [22] revealed that moderate-intensity exercise may lower preterm LBW rates in the preterm LBW group. According to earlier research, LBW may benefit from appropriate physical exercise [23,24]. In addition to influencing endocrine regulation of fetal growth and promoting an increase in the ratio of muscle to adipose tissue mass, moderate-intensity physical activity during pregnancy has been shown to extend gestational age and lower the risk of LBW babies [25]. The relationship between physical activity and preterm LBW may be challenging to precisely assess in earlier research, though, because of the variety and forms of physical activity as well as possible recollection bias.

Conversely, **Bisson *et al.*** [18] discovered that LBW babies were born to pregnant women who participated in intense sports or activity during the first trimester. **Pathirathna *et al.*** [16] also pointed out that univariate studies revealed no connections between PA during pregnancy and neonatal birthweight, gestational age, or gestational weight increase. Conversely, research by **Takito and Benício** [26] found that mild PA had a protective effect against LBW and premature delivery, whereas other studies have found that moderate or intense occupational PA increased the risk of intrauterine growth restriction [27].

In this study, moderate physical activity was found in 40.00% of patients under cesarean section, and mild physical activity was found in 30.30% of patients under cesarean section and in 83.33% of patients under normal vaginal delivery with significant relation among the studied groups. While there wasn't significant relation among the studied groups regarding LBW (P=0.428). Pregnancy-related exercise was linked to fewer instrumental deliveries but not to the risk of CS delivery [28]. The fact that this last meta-analysis reference covered all forms of CS could explain the discrepancy in the findings. A possible explanation for the link between PA and emergency CS is that pregnant women with a lower level of PA had a higher probability of exceeding the IOM recommended GWG and a GWG above the guidelines is associated with an increased risk of emergency CS [29].

In the current investigation, maternal age was significantly decreased among patients with LBW than patients without LBW. Regarding occupation, non-employee was found in 80.13% of patients without LBW and in all patients with a LBW with a significant relation among low-birth-weight groups. Residence as a rural area was recorded in 65.38% of patients without LBW and in 0.00% of patients with LBW and a city was recorded in 34.62% of patients without LBW with significant relation among the studied groups.

Our results contrast with a study, according to a Gujarati study by **Mumbare *et al.*** [30], mother age was not a risk factor for LBW. Our findings were in conflict with those of Iranian research that found that working women had lower neonatal birthweights than unemployed women [31]. Additionally, **Hassan *et al.*** [1] discovered no correlation between the weight of the newborns and the mother's age. LBW was shown to be associated with the employment status of the mother. **Legesse *et al.*** [9] found that most of the neonates who LBW were residents of rural areas (86.11%).

In the current study, pregnancy BMI, and maternal weight gain were significantly increased among patients without LBW than patients with LBW. In a previous study by **Devaki and Shobha** [32] **and Mohammadi *et al.*** [33] obesity increases the risk of LBW, while in research by **Sindiani *et al.*** [34] the mother's BMI and LBW did not significantly correlate. Nonetheless, the study did find a link between LBW risk and prenatal weight increase. The chance of giving birth to LBW babies was greater for pregnant women who gained 6–10 kg throughout their pregnancy than for those who gained 10–16 kg. These results align with a prior study by **Zhao *et al.*** [35] that found pregnant women who gained less than the American Institute of Medicine's recommended range of gestational weight gain (11.3–15.9 kg for those with normal pre-BMI) were more likely to give birth to LBW babies than women who gained more than this range.

In our study, parity as 1–2 children were found in 65.38% of patients without LBW and in 62.50% of patients with LBW. In contrast of our results, **Xi *et al.*** [22] found that in the preterm LBW, term LBW, and control groups, the percentage of parity greater than one was 37.4, 36.0, and 45.5%, respectively.

CONCLUSION

Women who live in rural areas are exposed to high physical activity. Our study showed that women who weren't exposed to physical activity have a risk of having babies with LBW. 83.33% of women with mild physical activity were delivered by cesarean section.

While with moderate physical activity, all women delivered by cesarean section**.**

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