

## Research Article

# Effects of Nutritional Status and Habits During Pregnancy on Term and Preterm Births

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### Abstract

**Objectives:** This study was designed to explore nutritional status and behaviors in pregnancy and investigate the effects on preterm and term births.

**Methods:** The study was conducted with 120 mothers who gave birth (60 preterm and 60 term deliveries) in a private hospital between November 2015 and December 2015 in Istanbul. A questionnaire to record the demographic characteristics of patients, smoking and alcohol use, nutritional habits, and food consumption frequency was administered in a face-to-face interview.

**Results:** In all, 65% of the births were by cesarean section and 35% were vaginal delivery; 41.7% of the preterm deliveries were in women aged  $\geq 35$  years, whereas only 5% of term deliveries were in women aged  $\geq 35$  years. Statistically significant differences were found in terms of education, work status, income level, smoking, pregnancy nutrition, and psychological status between preterm and term delivery mothers ( $p < 0.05$ ). Gestational weight gain was  $\leq 8$  kg in 36.7% of mothers with preterm deliveries and  $\geq 12$  kg in 36.7% of mothers and 8-12 kg in 68.3% of the mothers with term deliveries. Compared with preterm delivery mothers, term delivery mothers had fewer nutritional problems during pregnancy and more regular meal consumption ( $p < 0.05$ ).

**Conclusion:** Weight gain and nutrition in pregnancy are variables that affect preterm birth. Hence, nutritional training should be provided regularly to pregnant women, and their weight should be monitored.

**Keywords:** Nutrition, pregnancy, preterm, term

Increasing need for energy, protein, vitamins, and minerals during pregnancy, which is a physiological condition, increases the importance of nutrition for the mothers.<sup>[1]</sup> Nutrition during pregnancy is very important for healthy and smooth pregnancy course, prevention of complications that may arise, and for the fetus to attain sufficient weight, complete organ development, especially the brain and be born in time. Therefore, nutritional habits should be observed during pregnancy, and sufficient nutritional

training should be given to pregnant women for increased awareness.<sup>[2]</sup>

There are frequent changes in body weight during pregnancy. Gestational weight gain should be monitored<sup>[3, 4]</sup> because any increase or decrease in the weight during this time may lead to pathological changes in the birth weight of the baby, thereby resulting in significant consequences for the baby. The World Health Organization (WHO) recommends that gestational weight gain should be deter-

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**Table 1.** BMI categories (5)

BMI categories	Recommended weight gain (kg)	Recommended weight gain (kg/month)
Underweight	12.5-18	2.3
Normal weight	11.5-16	1.8
Overweight	7-11.5	1.2
Obese	<7	0.9

BMI: Body mass index; kg: Kilogram.

mined using maternal pre-pregnancy body mass index (BMI) (Table 1).<sup>[5]</sup>

There are comprehensive and valid arguments that biological, metabolic, and social factors are determinants of maternal body weight gain. It has been suggested that the proposed low weight gain in pregnancy is associated with intrauterine growth retardation (IUGR), low birth weight (SGA), and perinatal mortality; high maternal weight gain (LGA) is associated with frequent complications related to pelvic noncompliance in the birth process.<sup>[6]</sup>

Dietary habits need to be rescheduled before and during pregnancy to maintain a healthy gestational course, achieve the ideal weight of the fetus, and have adequate nutrient storage. In prepregnancy and particularly during the gestation period, deficient and unbalanced nutrition with protein, vitamin, and mineral deficiencies may lead to miscarriage risk, premature birth risk, low birth weight, mental retardation, and congenital disorders.<sup>[7, 8]</sup>

This study was conducted to determine the nutritional status and behaviors in pregnancy and investigate their effects on preterm and term births.

## Methods

The study was conducted on 120 mothers (60 preterm and 60 term deliveries) who delivered in a private hospital in Istanbul. The study was conducted between November 2015 and December 2015 with selected participants among volunteers by random sampling method.

The questionnaire was administered to participants, including demographics, smoking status, alcohol use, eating habits, and frequency of food consumption. The questionnaire was administered using the face-to-face interview method. Prepregnancy body weight and length were examined using patient files, postpartum weight was measured by the investigator with precision scales, and BMIs were calculated by investigator. Preterm infants were classified according to the WHO classification based on infant birth weeks: <28 weeks, extremely preterm birth; 28–32 weeks, moderate preterm birth; and 32–37 weeks, preterm birth.<sup>[9]</sup>

## Statistical Evaluation of Data

The evaluation of the data was performed using SPSS 23.00 statistical program. Descriptive statistical methods (mean, standard deviation) were used for evaluating the study data. Normality assumption for continuous variables was tested using the Kolmogorov–Smirnov test. In a normal distribution, averages were compared using the Student's t-test. The chi-square method was used to compare percentages and ratios. The results were evaluated at 95% confidence interval, and significance was set at  $p < 0.05$ .

## Results

In our study, 91.7% of mothers who have term delivery and 56.6% of mothers who underwent preterm delivery were aged 20–34 years. Furthermore, 58.3% of mothers who have term deliveries were university graduates, and 66.7% of mothers who underwent preterm deliveries were housewives. It was observed that 51.7% of preterm delivery mothers and 95% of term delivery mothers went to prenatal health control programs ( $p < 0.05$ ). Additionally, 90% of preterm delivery mothers had health problems, and the risk of preterm delivery was found to be approximately 70%; 93.3% of term delivery mothers did not have any health problems. Psychological problems were experienced by 81.7% of preterm delivery mothers and 26.7% of term delivery mothers ( $p < 0.05$ ). Furthermore, 63.3% of preterm mothers never smoked and 21.7% quit during pregnancy; 93.3% of term delivery mothers did not smoke at all and 5% quit during pregnancy ( $p < 0.001$ ). Regarding exposure to cigarette smoke, 70.7% of preterm delivery mothers were exposed to cigarette smoke by their husband (70.7%); 33.3% of term delivery mothers were also exposed to cigarette smoke, but 35% of term delivery mothers were not ( $p < 0.05$ ) (Table 2).

Weight gain was  $\leq 8$  kg in 36.7% and  $> 12$  kg in 36.7% of preterm delivery mothers during the gestational period; 35% of term delivery mothers had a weight gain between 10 and 12 kg and 33.3% between 8 and 10 kg ( $p < 0.001$ ). It was observed that 88.3% of preterm delivery mothers and 25% of term delivery mothers experienced nutritional problems during pregnancy ( $p < 0.05$ ). The most common nutritional problems in pregnancy for preterm delivery mothers were stomach discomfort in 46.7%, flatulence in 45%, constipation in 43.7%, and nausea and vomiting in 43.7%, and in the term, delivery was fear of weight gain by 16.7%. Regarding meal consumption during pregnancy, 73.3% of preterm delivery mothers and 100% of term delivery mothers had breakfast every day, 65% of preterm delivery mothers and 96.7% of term delivery mothers had lunch every day, and 98.3% of term delivery mothers and

**Table 2.** General characteristics of individuals with respect to demographics and gestational term

	Preterm deliver (n=60)		Term delivery (n=60)		p
	n	%	n	%	
Age					<0.001*
17–19	1	1.7	2	3.3	
20–34	34	56.6	55	91.7	
≥35	25	41.7	3	5.0	
Educational status					<0.001*
Primary	7	11.7	-	-	
Middle school	9	15.0	6	10.0	
High school	28	46.7	19	31.7	
University	16	26.7	29	48.3	
Graduate	-	-	6	10.0	
Work					0.001*
Housewife	40	66.7	16	26.7	
Worker	1	1.7	1	1.7	
Officer	1	1.7	4	6.7	
Other	18	30.0	39	65.0	
Working status					<0.001*
Working	3	5.0	11	18.3	
Not working	46	76.7	15	25.0	
Maternity leave	11	18.3	34	56.7	
Income status					<0.001*
Over-income	16	26.7	42	70.0	
Equal to income	36	60.0	16	26.7	
Lower than income	7	11.7	2	3.3	
Less than income	1	1.7	-	-	
Prenatal health check					<0.001*
Yes	31	51.7	57	95.0	
No	1	1.7	1	1.7	
Not regular	17	28.3	2	3.3	
Needed	11	18.3	-	-	
Health problem					<0.001*
No	6	10.0	56	93.3	
Yes	54	90.0	4	6.7	
Risk of premature birth	42	70.0	-	-	<0.001*
Hypertension	9	15.0	-	-	0.003*
Gestational DM	17	28.3	4	-	0.003*
Others	3	5.0	-	-	0.244
Psychological problem					<0.001*
No	11	18.3	44	73.3	
Yes	49	81.7	16	26.7	
History of smoking					0.001*
Smoker	2	3.3	1	1.7	
Sometimes	7	11.7	-	-	
Quit smoking during pregnancy	13	21.7	3	5.0	
Never smoked	38	63.3	56	93.3	
Exposure to cigarette smoke (n=118)					<0.001*
Yes, my husband	41	70.7	14	23.3	
Yes, around me	6	10.3	5	8.3	
Yes, outside	4	6.9	20	33.3	
No	7	12.1	21	35.0	

\*p&lt;0.05, multiple choices were made in health problems; n, number of participants.

**Table 3.** Weight gain and nutrition characteristics of pregnant women

	Preterm delivery (n=60)		Term delivery (n=60)		p
	n	%	n	%	
Weight gain					<0.001*
<8 kg	22	36.7	9	15.0	
8.1-10.0 kg	10	16.7	20	33.3	
10.1-12.0 kg	6	10.0	21	35.0	
>12.1 kg	22	36.7	10	16.7	
Nutritional problem					<0.001*
No	7	11.7	45	75.0	
Yes	53	88.3	15	25.0	
Which nutritional problem					
Fear of weight gain	13	21.7	10	16.7	0.643
Nausea, vomiting	26	43.3	4	6.7	<0.001*
Stomach diseases	28	46.7	4	6.7	<0.001*
Constipation	27	45.0	1	1.7	<0.001*
Daily meal consumption					
Breakfast					<0.001*
Everyday	44	73.3	60	100.0	
Every other day	15	25.0	-	-	
1-2 times a week	1	1.7	-	-	
1-2 times a month	-	-	-	-	
Never	-	-	-	-	
Lunch					<0.001*
Everyday	39	65.0	58	96.7	
Every other day	14	23.3	2	3.3	
1-2 times a week	6	10.0	-	-	
1-2 times a month	-	-	-	-	
Never	1	1.7	-	-	
Dinner					0.038*
Everyday	50	83.3	59	98.3	
Every other day	5	6.7	1	1.7	
1-2 times a week	4	6.7	-	-	
1-2 times a month	1	1.7	-	-	
Never	-	-	-	-	

\*p<0.05: multiple choices were made for diseases; n: number of participants; kg: kilogram.

83.3% of preterm delivery mothers had dinner every day ( $p<0.05$ ) (Table 3).

According to prepregnancy BMI examination, 43.3% of preterm delivery mothers were normal, 25% were overweight, 20% were obese; 28.3% became overweight and 45% obese after pregnancy. In addition, 76.7% of term delivery mothers were normal, 8.3% were overweight, and 1.7% were obese before pregnancy, whereas 66.7% were normal, 25% were overweight, and 8.3% were obese after pregnancy; the BMI values found to be statistically different between groups ( $p<0.05$ ) (Table 4).

## Discussion

Many risk factors leading to premature birth have been identified, including advanced age, low education level, unemployment, socioeconomic status, smoking habit or cigarette smoke exposure, alcohol consumption, drug consumption, chronic health problems, medication use, and inadequate and unbalanced nutrition. Most women nowadays delay their pregnancy plans due to late start of family life and more prominent economic freedom. However, advanced age is a very important factor in terms of pregnancy progress and birth prognosis. Due to increased age, the risk of chronic diseases, such as hypertension and diabetes,

**Table 4.** Pre-and post-pregnancy BMI categories of individuals

BMI categories	Preterm delivery (n=60)		Term delivery (n=60)		p
	n	%	n	%	
Pre-gestational					<0.001*
Underweight	7	11.7	8	13.3	
Normal weight	26	43.3	46	76.7	
Overweight	15	25.0	5	8.3	
Obese	12	20.0	1	1.7	
Post-gestational					<0.001*
Underweight	-	-	-	-	
Normal weight	16	26.7	40	66.7	
Overweight	17	28.3	15	25.0	
Obese	27	45.0	5	8.3	

\*p<0.05; n: Number of participants; BMI: Body mass index.

are increasing.<sup>[10]</sup> In the study of Harlow et al.,<sup>[11]</sup> it was observed that there was an increased risk of premature birth in mothers aged  $\geq 30$  years. In this study, 41.7% of preterm delivery mothers were aged  $\geq 35$  years. The increased risk of diseases prevalence with advanced age can harm the baby and lead to premature birth.

Socioeconomic status is also a factor directly related to preterm birth. A poor socioeconomic status may lead to premature birth. Between 1996 and 2006, births in nine countries were examined, and mothers with poor socioeconomic status had a higher rate of preterm delivery.<sup>[12]</sup> In another study, the socioeconomic status of preterm delivery mothers was examined, and it was found that infants from low- and middle-income families were born with a higher preterm birth rate and low birth weight.<sup>[13]</sup> In our study, most preterm delivery mothers (66.7%) and only 26.7% of term delivery mothers were housewives. In addition, incomes and expenditures of preterm delivery mothers (60%) were equal, whereas the outcomes were higher than the expenditures in most term delivery mothers (70%).

From the beginning of pregnancy, medical controls are important for healthy pregnancy for both the mother and baby and aimed at determining the presence of any disease in mothers and preventing possible harms to the mothers and baby. In a study conducted in Turkey (n=200), the frequency of antenatal care differed according to socioeconomic status, monthly income, social security, educational status, and number of pregnancy; also, there was a remarkable finding that some women with high economic status and education did not receive antenatal care.<sup>[14]</sup> In this study, 51.7% of preterm delivery mothers and 95% of term delivery mothers attended prenatal care (p<0.05), which was possibly because term delivery mothers had

high educational and socioeconomic status and were more conscious.

In addition, presence of diseases in the mother can lead to premature birth. In this study, 90% of preterm delivery mothers had health problems. Mood disorders after and during pregnancy affect many mothers.<sup>[15]</sup> In one study, 3.8% of mothers had psychological disorders,<sup>[16]</sup> whereas in another study, 54% of females experienced anxiety and 37.1% experienced depression.<sup>[17]</sup> Furthermore, another study found that psychological disorder and preterm delivery were moderately related.<sup>[18]</sup> In our study, preterm delivery mothers had more psychological problems than term delivery mothers.

The mechanism via which cigarette smoking affects pregnancy remains unclear. Theoretically, carbon monoxide reduces fetal hypoxia, leads to calcium signal degradation, changes steroid hormone production, degrades prostaglandin synthesis, and changes the response to oxytocin, which leads to premature birth.<sup>[19]</sup> Studies have shown that females exposed to cigarette smoke may also undergo preterm delivery. In a study on 164,905 people, those exposed to cigarette smoke were found to have premature births.<sup>[20]</sup> In another study (n=102), the preterm delivery rate of mothers with smoking habit was found to be higher.<sup>[21]</sup> Another study conducted on 922 premature and 965 late birth mothers found that 38% of premature births were in females who smoked during pregnancy.<sup>[22]</sup> In this study, 21.7% of preterm delivery mothers quit smoking during gestation, 11.7% were occasional smokers, and 3.3% were smokers during pregnancy; 93.3% of term delivery mothers did not smoke at all. Regarding smoke exposure without smoking, it was found that preterm delivery mothers were generally exposed to cigarette smoke

by their husband (70.7%), whereas 33.3% of term delivery mothers were exposed to cigarette smoke from outside ( $p < 0.05$ ). Smoking and smoke exposure rates in preterm delivery mothers were higher than those of term delivery mothers, which were consistent with the data in literature.

Compared with the condition 60 years ago, currently, there have been many radical changes in the proposals made to increase the body weight of women during pregnancy. It was suggested in the 1920s that the body weight gain of pregnant woman should be not more than 6.8 kg for easier delivery and protection of physical structure after pregnancy.<sup>[23]</sup> During the 1940s, restriction of body weight gain in pregnancy was frequently resorted to, believing in the existence of a close relationship between overweight and pre-eclampsia.<sup>[24]</sup> It has been postulated that after 1970 years, neonatal mortality with low body weight gain in pregnancy and low birth weight in infants which is the most important effect for morbidity.<sup>[25]</sup> Weight gain during pregnancy was also associated with premature birth. For example, in a study conducted on 102 patients, gestational weight gain of  $\geq 12$  kg, cigarette use, and low educational status caused preterm birth.<sup>[26]</sup> In this study, 36.7% of preterm delivery mothers had weight gain of  $\geq 12$  kg. Majority (68.3%) of term delivery mothers had weight gain between 8 and 12 kg, and the difference was significant ( $p < 0.05$ ). Our results emphasized the importance of balanced weight gain during pregnancy for term and preterm deliveries, similar to the literature.

Studies have shown that body weight gain in pregnancy depends on sociodemographic and maternal characteristics, such as BMI at the start of pregnancy, age, education level, and ethnicity.<sup>[27]</sup> In addition, maternal anthropometry varies between populations.<sup>[28]</sup> Many studies support the association between BMI and preterm birth. In particular, increased BMI leads to premature birth.<sup>[29]</sup> In a study examining the relationship between BMI and preterm birth, the prevalence of BMI  $< 19.8$  in pregnancy was associated with preterm birth.<sup>[30]</sup> In another study, obese women were examined, and a relationship between increased BMI and preterm delivery was observed.<sup>[31]</sup> In addition, in another study, increased BMI correlated with preterm birth.<sup>[32]</sup> The increase in BMI reduces the cervical length to  $< 25$  mm, leading to preterm birth.<sup>[33]</sup> It was observed that 11.7% of preterm delivery mothers were thin, and 45% of them had a risk of obesity; 13.3% of term delivery mothers were thin and 76.7% were normal ( $p < 0.05$ ). The results showed that prepregnancy BMI is in the normal range as well as weight gain at term and preterm birth at gestation.

## Conclusion

The proportion of preterm delivery mothers aged  $\geq 35$  and 20-34 years is similar, and most term delivery mothers are aged 20-34 years. Preterm delivery mothers have lower socioeconomic status, and most are not working at all. The vast majority of mothers who give normal birth regularly visit healthcare systems and have no health problems. The vast majority of preterm delivery mothers have health and psychological problems. Preterm delivery mothers have a high rate of cigarette smoke exposure, although not many of them are smokers. The prevalence of preterm delivery is higher in mothers with high BMI during prepregnancy phase. Term delivery mothers pay more attention to nutrition and regular meal consumption and change their dietary habits.

Preterm births are influenced by many factors, including mother's weight gain and nutrition during pregnancy. The rate of preterm births with high mortality and morbidity can be reduced with regular weight follow-up and healthy nutrition training provided to pregnant women.

## Disclosures

**Ethics Committee Approval:** Our study was approved by the Ethics Committee of Istanbul Gelisim University with the letter dated 28.09.2015 and numbered 2015-2016.

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** None declared.

**Authorship contributions:** Concept – H.P.D., C.I., H.M.B., S.Y.; Design – H.P.D., C.I., H.M.B., S.Y.; Supervision – H.P.D., C.I., H.M.B., S.Y.; Materials – H.P.D., C.I., H.M.B., S.Y.; Data collection &/or processing – H.P.D., C.I., H.M.B., S.Y.; Analysis and/or interpretation – H.P.D., C.I., H.M.B., S.Y.; Literature search – H.P.D., C.I., H.M.B., S.Y.; Writing – H.P.D., C.I., H.M.B., S.Y.; Critical review – H.P.D., C.I., H.M.B., S.Y.

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