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Impact of Sleep Quality and Daily Activity on Maternal and Neonatal Development Parameters in Primigravid Pregnant Women

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Abstract

Background: During the first pregnancy, movement restrictions that develop due to the instinct to protect the baby are more susceptible to gestational weight gain (GWG). This situation can negatively affect maternal and neonatal health by impacting maternal sleep quality. The aim of this study is to examine the relationship between weight gain during pregnancy in first pregnancies and sleep quality, health, and neonatal outcomes.

Methods: In this prospective cross-sectional comparative study, 180 primigravid pregnant women were evaluated. These women were divided into Normal Gestational Weight Gain (NGWG, ≤16 kg) and High Gestational Weight Gain (HGWG, >16 kg) groups according to American College of Obstetricians and Gynaecologists (ACOG) criteria. The obtained International Physical Activity Questionnaire – Short Form (IPAQ-SF), Pittsburgh Sleep Quality Index (PSQI), and maternal and neonatal data were analysed using the Mann-Whitney U test.

Results: The daily sitting duration was significantly higher in the HGWG group ($p=0.029$). PSQI scores were found to be significantly worse in the HGWG group (7.50 ± 2.88) compared to the NGWG group (5.77 ± 2.98) ($p < 0.001$). Additionally, it was found that labor duration was significantly longer in the HGWG group ($p=0.047$), and neonatal birth weight, length, and ponderal index values were higher ($p<0.05$).

Conclusions: In primigravid women, high gestational weight gain was associated with greater physical inactivity, poorer sleep quality, and longer labor duration. Increasing activity and maintaining weight control during this period may be fundamental protective health interventions for improving maternal sleep quality and labor processes.

Trial registration: Thai Clinical Trials Registry (TCTR20251028006), registered 28 October 2025 .

Keywords: Primigravid Pregnant Women, Sleep Quality, Duration of labor, Neonatal Parameters

Background

Pregnancy is a dynamic process involving physiological, metabolic, and hormonal changes that affect the health of both the mother and the fetus. One of the most critical factors to manage during this process is gestational weight gain (GWG) [1]. According to data from

the American College of Obstetricians and Gynecologists (ACOG), approximately 48% of pregnant women gain weight above the recommended limits [2,3]. Excessive GWG during pregnancy can lead to serious obstetric complications such as gestational diabetes and hypertensive disorders in the mother, and macrosomia and shoulder dystocia in the fetus [4–6]. Compounding the problem are long-term risks; women who experience hypertension or diabetes complications during pregnancy have been shown to have an increased risk of cardiovascular disease, myocardial infarction, stroke, deep vein thrombosis, and mortality in their later years [7,8]. For this reason, in 2009, IOM (Institute of Medicine) minimized the effects of excessive or insufficient GWG on the mother and baby at the beginning of pregnancy by categorized mothers into groups based on their Body Mass Index (BMI) (underweight, normal, overweight, and obese) and determined the recommended GWG norms for each group. In 2013, ACOG also endorsed these recommendations as a statement of opinion and reaffirmed them in 2020 [9].

Minimizing these risks requires identifying the factors that promote healthy GWG during pregnancy. Physical activity is at the top of this list. Physical activity is defined as body movements that result in energy expenditure through the contraction of skeletal muscles [10,11]. However, as pregnancy progresses, hormonal changes and the "instinct to protect the baby" cause primigravid pregnant women to adopt a more sedentary lifestyle and limit their physical activity. Yet, it is a well-known fact in the literature that individuals with low physical activity are more prone to obesity and excessive GWG. Experimental studies have shown that regular physical activity during pregnancy can be performed with minimal risk and significantly reduces the risk of diabetes, hypertension, and musculoskeletal pain [12–15].

One of the most important processes thought to be affected by physical activity and weight control is labor. Labor is a physiological process involving uterine contractions to expel the fetus, dependent on mother-fetus interaction. Prolonged labor can lead to atony and increased caesarean rates in the mother, and complications such as hypoxia in the baby. Although recent studies have focused on the effect of physical activity on labor parameters, the results are controversial. Some studies have reported that lack of physical activity prolongs the gestational period [16], while active primigravid pregnant women have a lower risk of preterm birth [17]. On the other hand, while some studies suggest that physical activity shortens the first and second stages of labor and reduces perineal lacerations [18,19], other studies have reported negative or neutral results [20,21]. This situation highlights the need for further research on the subject.

Another important parameter that directly affects the mother's quality of life during pregnancy is sleep quality. Although sleep duration increases towards the third trimester of pregnancy, it is known that there are significant impairments in sleep quality [22,23]. These parameters such as frequent urination, fetal movements, and gastroesophageal reflux reduce sleep quality [24–26]. Sleep disturbances during pregnancy may have significant maternal and fetal consequences. For instance, a meta-analysis reported that reductions in sleep duration and sleep quality are associated with an increased risk of preterm birth. In addition, the same study demonstrated a significant relationship between sleep disturbances and perinatal depression [27]. Moreover, previous studies have indicated that impaired sleep during pregnancy is linked to a higher risk of gestational diabetes, caesarean delivery, postpartum depression, and preeclampsia [28]. The adverse effects of sleep disturbances on the fetus have also been documented [29], with evidence suggesting an association with an increased risk of abortion [30].Considering all these findings, the presence of adverse pregnancy outcomes in women with poor sleep quality highlights the particular importance of investigating factors related to sleep quality during pregnancy.

Since most pharmacological treatments used in the adult population are considered contraindicated during pregnancy by the Food and Drug Administration (FDA) due to their potential effects on the fetus, non-pharmacological approaches are gaining importance. In this context, there is strong evidence that lifestyle changes such as exercise and diet, as well as meditation, cognitive behavioral therapies, and dietary modifications (caffeine and fluid restriction) [31], improve sleep quality [11,32].

A review of the current literature reveals that while the effect of physical activity on birth parameters has been frequently studied, there are limited studies examining the combined effects of excessive GWG during pregnancy, resulting from insufficient physical activity, on both birth parameters and sleep quality. In particular, the effect of excessive GWG on sleep as a preventive factor has not been sufficiently elucidated [33–35].

In this context, the aim of our study is to examine the relationship between weight gain during pregnancy and birth outcomes (duration, mode of delivery, etc.) as well as the mother’s sleep quality.

Methods

Participants and Determining Groups

The current study is a prospective cross-sectional comparative study conducted between October-December 2025 during the 3rd trimester and with 460 primigravid pregnant women who applied to the obstetrics and gynaecology clinic for delivery. Sample size was calculated using prospective power analysis with G*power 3.1 software [36,37]. The analysis was based on the Wilcoxon-Mann-Whitney test, which allows for a non-parametric comparison between two independent groups; it was performed with 95% statistical power ($\boldsymbol{1-\beta} = 0.95$), a 5% significance level ($\boldsymbol{\alpha} = 0.05$), one-way, and effect size ($\boldsymbol{d} = 0.90$). It was determined that 64 participants needed to be included in each group to identify differences between groups. The study continued with 181 participants.

The initial cohort comprised 460 primigravid pregnant women at 36 weeks and above. Among these primigravid pregnant women, 181 were in their first pregnancy and healthy. As all participants had a pre-pregnancy BMI within the normal WHO range, the 16-kilogram threshold corresponds to the upper bound of the gestational weight gain recommended for this BMI category by the American College of Obstetricians and Gynaecologists (ACOG). The Normal Gestational Weight Gain Group (NGWG) included participants who gained 16 kilograms or less for the duration of pregnancy, while the High Gestational Weight Gain Group (HGWG) included participants who gained 16 kilograms or above, in accordance with the ACOG criteria [38]. Of these 181 participants, 1 outlier participant with extreme weight gain or loss was excluded, and the study continued with a total of 180 participants, comprising the Normal Gestational Weight Gain Group (NGWG, n = 126) and the High Gestational Weight Gain Group (HGWG, n = 54). While the NGWG exceeded the a priori target of 64 participants per group, the HGWG fell short of this target (n = 54 vs. 64), which should be considered when interpreting the statistical power of HGWG-related comparisons (see Limitations).

Inclusion and Exclusion Criteria

Inclusion criteria were women aged 20–35 years, without mental or cognitive impairment, a pre-pregnancy body mass index within the normal WHO range (18.5–24.9 kg/m²), able to communicate effectively with researchers or complete questionnaires

independently, and who had a vaginal delivery between 36 and 42 weeks at the same hospital. Women with a second or subsequent pregnancy, multiple pregnancies, malpresentation, placenta accreta, placenta previa, intrauterine growth restriction, oligohydramnios or polyhydramnios, hypertensive disorders of pregnancy, orthopaedic limitations, neurological disorders, a history of uterine surgery, or a history of caesarean delivery were excluded from the study. Non-volunteers and people not speaking Turkish were excluded from the study. Exclusion criteria for participants were unreasonable errors in the completed questionnaire and missing or outlier data that affected the analysis of the study results. To make the study more reliable, we compared the information in the questionnaires with the patient's electronic medical records. The study was conducted with the approval of the Ethics Committee, dated 30/07/2025, and numbered 20/478/486/3344 and Trial Registration: TCTR20251028006-28.10.2025 (Thai Clinical Trials Registry). The study was conducted in accordance with the Helsinki Declaration, with participants' personal information protected. All participants have declared that they participated in the study voluntarily. Additionally, these participants were informed of the study objectives and provided voluntary consent by signing the survey consent form and a separate consent form for access to their medical records.

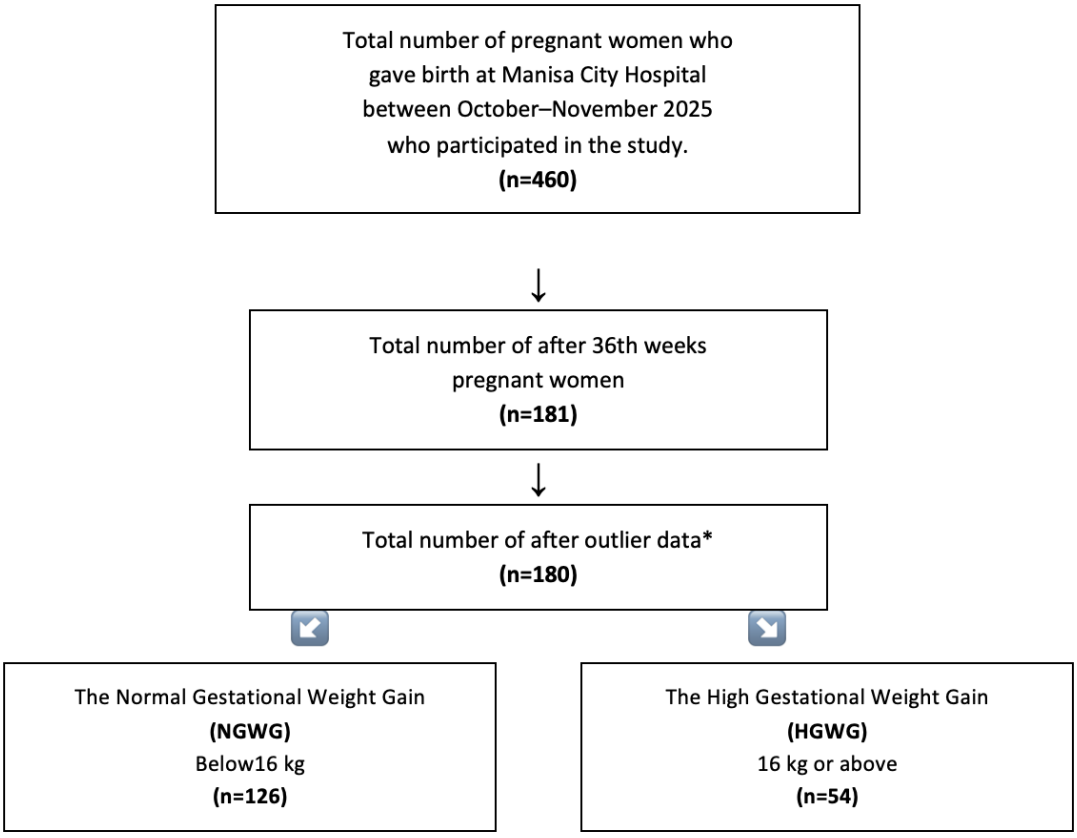


Figure 1. Participant Selection Flow Chart

Study Design

All participants were given an informed consent form and questionnaire explaining the objectives of the study. Permission to access medical records was also obtained. Anthropometric data (body weight, height, and BMI) of the participating primigravid pregnant women were measured when they presented for labor, and maternal GWG during pregnancy was calculated. Maternal labor parameters, including active labor time, fetal head level, labor induction status, episiotomy status, perineal laceration status, neonatal birth weight and height were obtained from patient records. Furthermore, the activities of the primigravid pregnant women during the last week were assessed using the International Physical Activity Questionnaire Short Form (IPAQ-SF). Sleep patterns during the last month were assessed using the Pittsburgh Sleep Quality Index (PSQI). In the second phase, electronic medical records were analysed. The gestational age of participants was determined by examining the date of their last menstrual period and ultrasound records taken before the 20th week.

Gestational Week Calculation

To ensure high methodological accuracy, the gestational week for all participants was determined according to the protocol based on the ACOG guidelines [39]:

1. If the last menstrual period (LMP) was reliable and consistent with early ultrasound measurements within a range of +/- 7 days, the gestational age determined based on the LMP was accepted.

2. If there was a discrepancy of more than 7 days between the LMP and ultrasound measurements, or if the LMP was uncertain or unknown, the gestational age was determined based solely on early ultrasound measurements.

Sitting Time and Walking Data Collection

The sitting and walking behaviours of primigravid pregnant women were assessed using the sitting and walking subscales of the International Physical Activity Questionnaire Short Form (IPAQ-SF) [40]. The Turkish version of the scale has been validated as a reliable tool for assessing physical activity [41]. The obtained sitting and walking data were included in the evaluation.

Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI) is a widely used questionnaire that assesses sleep quality and disturbances over the past month. The scale was initially developed by Buysse et al. in 1989 [42], and its reliability and validity in Turkish were later confirmed by Ağargün et al. in 1996 [43]. The PSQI is a 24-item questionnaire, with 19 items completed by the individual and the remaining five providing clinical information to be answered by a bed partner or roommate. Only the 19 self-reported items are used to calculate the score. These items are combined to create seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component is scored from 0 to 3, and the sum of these scores produces a global score ranging from 0 to 21. A higher PSQI score indicates poorer sleep quality [42,43]. Furthermore, the relationships between gestational GWG and sleep, maternal and neonatal parameters were determined using Spearman's correlation analysis [44]. Both the IPAQ-SF and the PSQI were self-administered by the participants. These surveys were administered at the time of admission to the hospital for delivery, after the onset of labor.

Maternal and Neonatal Variables

Episiotomy was not performed as a routine procedure; this is consistent with up-to-date international obstetric guidelines recommending a limited or selective episiotomy policy [45,46]. Rather than being used as a standard procedure to expedite delivery, this procedure was strictly limited to specific maternal or fetal clinical situations, such as non-reassuring fetal heart rate, expected severe trauma to the maternal perineum, or delivery with instruments [39,45].

The active stage of labor is defined as the period during which the cervix dilates from 5 cm (centimetres) to 10 cm. In our study, active labor is specifically defined as the period characterized by regular and intense uterine contractions, starting at a cervical dilation of 5 cm and leading to a progressive change in cervical condition. The second stage of labor is defined as the period from complete dilation of the cervix to the birth of the baby [47,48]. The third stage of labor is defined as the period from the birth of the baby to the delivery of the placenta and associated membranes.

In this study, we used the duration of labor as the active labor time. Active labor duration was estimated as the actual time (in minutes) from the moment the participant reached

the active phase threshold to full cervical dilation (10 cm). The progress of labor was monitored and recorded using an institutional partograph. To evaluate its relationship with our outcome parameters, the specific variables extracted from the partograph for statistical analysis were cervical dilation (cm) and fetal head position (descent).

Ponderal index was calculated as Birth Weight (gr) / Length $(cm)^3 \times 100$. Neonates with a ponderal index below 2.32 gr / cm^3 or above 2.85 g/cm^3 were classified as thin or obese, respectively [49].

Statistical Analysis

All statistical analyses were performed using JASP statistical software (version 0.19.2) [50]. The normality of the data was determined using the Shapiro-Wilk test and Kolmogorov-Smirnov analysis [51]. Since data were not normally distributed, non-parametric tests were used in all analyses. Pre- and post-intervention (postpartum) body weight and BMI values within each group were assessed using the Wilcoxon signed-rank test [52]. To compare the differences between the two independent participant groups (NGWG and HGWG), the Mann-Whitney U test was used. This test was applied to the IPAQ scores, PSQI scores (including subjective quality, sleep latency, sleep disturbances and daytime dysfunction), as well as maternal and neonatal birth outcomes such as duration of labour, fetal head station, labour induction, episiotomy/perineal tear, and neonatal birth weight, length and ponderal index. The effect sizes of the Mann-Whitney U test were interpreted as small (≈ 0.1), moderate (≈ 0.3) or large (≈ 0.5) [53]. Assumptions of multicollinearity were verified prior to the regression analyses [54]. Statistical significance was set at $p < 0.05$. Given the number of pairwise comparisons performed across the IPAQ, PSQI subcomponents, and maternal/neonatal outcomes, no correction for multiple testing (e.g., Bonferroni) was applied; consequently, p-values close to the significance threshold should be interpreted with caution. Confidence intervals for the Mann-Whitney U effect size estimates were not calculated.

Results

Participants Descriptive Information

The descriptive characteristics of the 180 pregnant women participating in the study were as follows: a mean age of 24.03 ± 3.63 years, a body height of 161.89 ± 5.80 cm, a body weight of 74.55 ± 11.76 kg, and body mass index (BMI) values of 28.48 ± 4.36 kg/m². When the participants were divided into subgroups based on their Gestational Weight Gain (GWG) values, no significant differences were found between the groups in terms of age ($\boldsymbol{U}$ = 3365,

$p = 0.976$, $r_B = -0.003$), body height ($U = 3232$, $p = 0.597$, $r_B = -0.050$), pre-pregnancy body weight ($U = 3130$, $p = 0.397$, $r_B = -0.080$), and pre-pregnancy BMI values ($U = 3116$, $p = 0.374$, $r_B = -0.084$).

Gestational Weight Gain (GWG)

Both subgroups demonstrated a significant increase in postpartum body weight ($z = 11.63$, $p < 0.001$) and postpartum BMI values ($z = 11.63$, $p < 0.001$) compared to their pre-pregnancy measurements. In the analysis of the subgroups, significantly higher GWG ($U = 4493$, $p = <0.001$, $r_B = 0.321$) and postpartum BMI values ($U = 4583$, $p < 0.001$, $r_B = 0.347$) were observed in the HGWG group compared to the NGWG group.

Sitting and Walking Data Outcomes

The sitting and walking results for the NGWG and HGWG groups were assessed using the Mann-Whitney U test. The analysis results revealed that the HGWG group had significantly longer sitting durations ($U = 2706$, $p = 0.029$, $r_B = -0.204$), but no significant difference was observed between the groups in terms of walking duration ($p > 0.05$; see Table 1).

Table 1. Sitting and Walking Outcomes

Parameters	ALL (N=180)	NGWG (n=126)	HGWG (n=54)	Δ	*p*	r_B
Sitting Time (minute)	520.37 ± 216.87	469.72 ± 29.56	542.08 ± 19.05	**-72.36**	**0.029**	**-0.204**
Walking Time (minute)	341.65 ± 274.79	375.51 ± 41.47	327.14 ± 23.29	**48.37**	**0.056**	**-0.084**

Note: ALL: All primigravid pregnant, NGWG: Normal gestational weight gain primigravid pregnant, HGWG: High gestational weight gain primigravid pregnant, Δ: Delta difference between groups, p: statistically significant $p < 0.05$, r_B : Rank-Biserial Correlation, min: minute

Sleep Quality Outcomes

Sleep quality parameters were compared between the NGWG and HGWG groups using the Mann-Whitney U test. Compared to the NGWG group, the HGWG group had significantly higher total PSQI scores ($U = 4538$, $p < 0.001$, $r_B = 0.334$), poorer subjective sleep quality ($U = 4053$, $p = 0.026$, $r_B = 0.192$), prolonged sleep latency ($U = 4282$, $p = 0.004$, $r_B = 0.259$), more sleep disturbances ($U = 4403$, $p < 0.001$, $r_B = 0.294$), and greater daytime dysfunction

($U = 4024$, $p = 0.026$, $r_B = 0.183$). In contrast, no significant difference was found between the groups in terms of sleep duration and habitual sleep efficiency ($p > 0.05$; Table 2, Figure 2).

Sleep Quality Rating

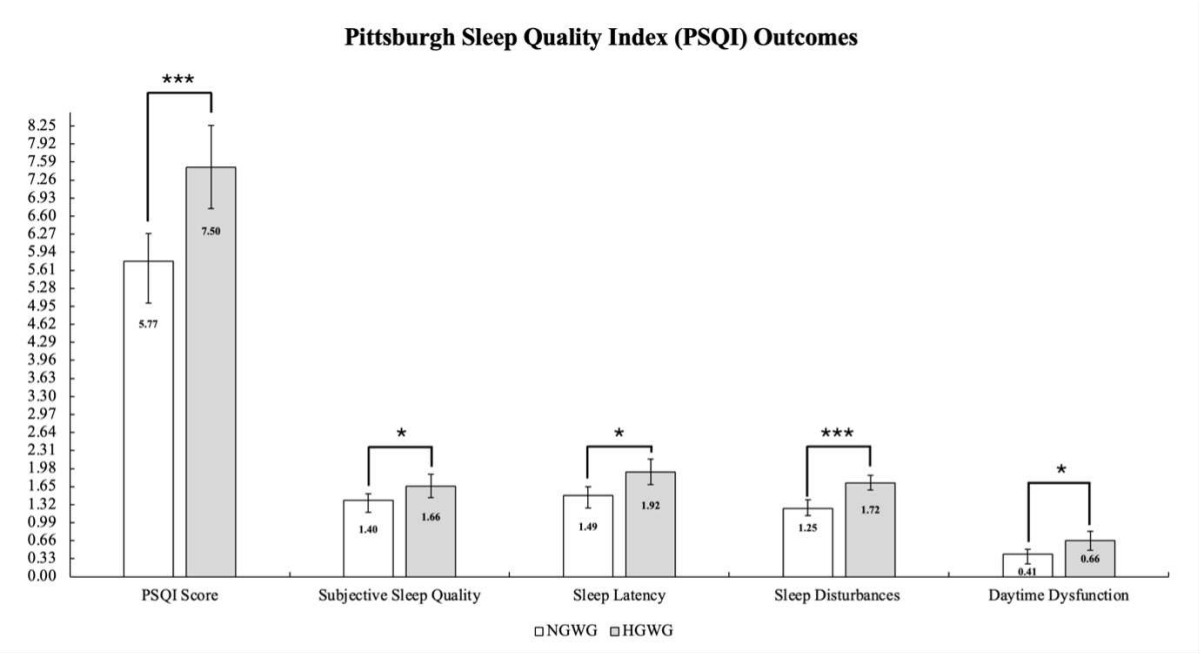
Sleep quality was classified according to total PSQI scores; scores below 5 indicate adequate sleep quality, while scores of 5 or above indicate poor sleep quality. Based on these thresholds, 71.29% of participants in the entire sample (mean PSQI score = 7.76) had poor sleep quality.

The prevalence of poor sleep quality was higher in the HGWG group (85.19%, mean PSQI score = 8.17) compared to the NGWG group (61.02%, mean PSQI score = 7.52). Regression analyses showed that total PSQI scores increased by 1.84 per kilogram of weight gain in the NGWG group, whereas in the HGWG group, they increased by 2.49 per kilogram of weight gain. Furthermore, it was found that for every additional kilogram gained above the 16-kilogram threshold, the likelihood of maintaining adequate sleep quality decreased by 3.68%.

Table 2. PSQI Outcomes

Parameters	ALL (N=180)	NGWG (n=126)	HGWG (n=54)	Δ	*P*	r_B
Subjective Sleep Quality	1.48 ± 0.75	1.40 ± .70	1.66 ±0.84	**0.26**	**0.026**	**0.192**
Sleep Latency	1.62 ±0.95	1.49 ± 0.94	1.92 ± 0.92	**0.43**	**0.004**	**0.259**
Sleep Duration	0.35 ± 0.83	0.30 ± 0.75	0.46 ± 1.00	**0.16**	**0.597**	**0..034**
Habitual Sleep Efficiency	0.93 ± 1.01	0.87 ± 1.01	1.07 ± 1.00	**0.20**	**0.173**	**0.121**
Sleep Disturbances	1.39 ± 0.80	1.25 ± 0.80	1.72 ± 0.68	**0.47**	**<0.001**	**0.294**
Daytime Dysfunction	0.48 ± 0.63	0.41 ± 0.58	0.66 ± 0.72	**0.25**	**0.026**	**0.183**
PSQI Score	6.28 ± 3.05	5.77 ± 2.98	7.50 ± 2.88	**1.73**	**<0.001**	**0.334**

Note: ALL: All primigravid pregnant, NGWG: Normal gestational weight gain primigravid pregnant, HGWG: High gestational weight gain primigravid pregnant, Δ: Delta difference between groups, p: statistically significant $p < 0.05$, r_B : Rank-Biserial Correlation



Note: Light-coloured bars represent normal gestational weight gain primigravid pregnant, while dark-coloured bars represent high gestational weight gain primigravid pregnant. The straight line represents the significance between groups. Statistical significance is indicated by an asterisk (***p <0.001, *p < 0.05). NGWG: normal gestational weight gain, HGWG: High gestational weight gain,

Figure 2. PSQI value at subgroups

Maternal and Neonatal Labor Parameters

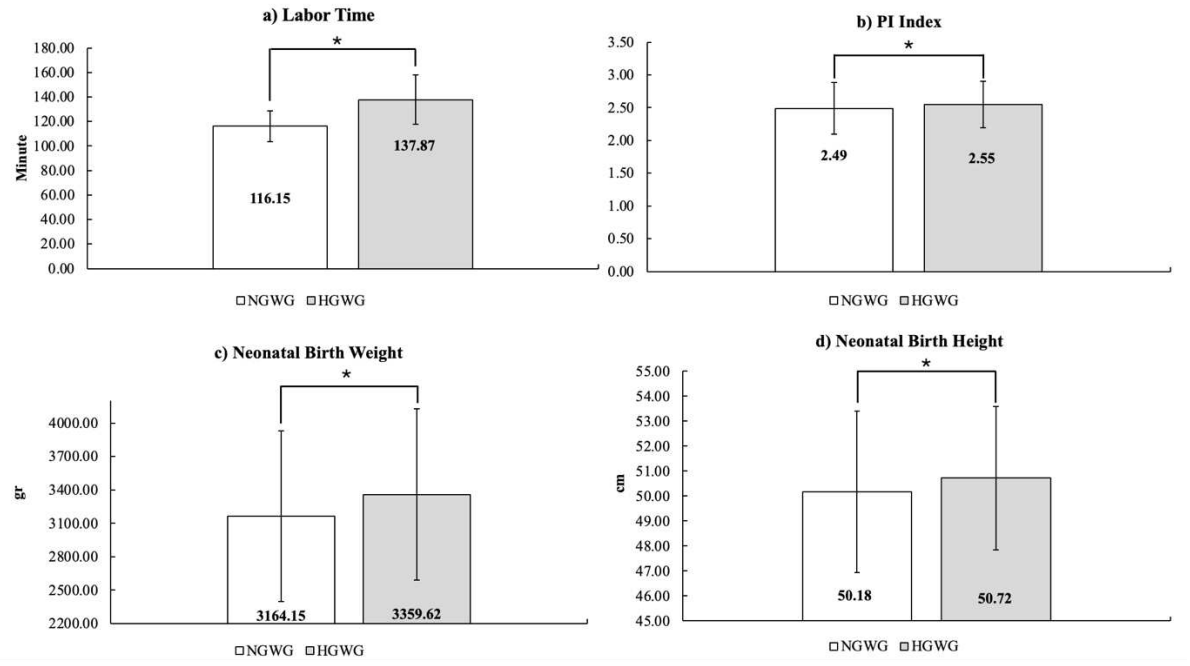
Maternal and neonatal birth parameters were assessed using the Mann-Whitney U test. The duration of active labor was significantly longer in the HGWG group compared with the NGWG group ($U = 4034$, $p = 0.047$, $r_B = 0.186$). Furthermore, neonates in the HGWG group had significantly higher birth weight ($U = 4239$, $p = 0.004$, $r_B = 0.270$), birth height ($U = 4145$, $p = 0.007$, $r_B = 0.251$), and ponderal index ($U = 4033$, $p = 0.039$, $r_B = 0.195$). No significant differences were detected between subgroups for the other maternal and neonatal birth parameters ($p > 0.05$; Table 3 and Figure 3).

Table 3. Maternal and Labor Parameters

Parameters	ALL (N=180)	NGWG (n=126)	HGWG (n=54)	Δ	*p*	r_B
Maternal Birth Parameters						
Labor Time (min)	122.66 ± 73.49	116.15 ± 71.84	137.87 ± 75.59	**21.72**	**0.047**	**0.186**

Labor Induction	1.31 ± 0.46	1.32 ± 0.47	1.27 ± 0.45	**-0.05**	**0.530**	**-0.048**
Episiotomy	1.17 ± 0.32	1.10 ± 0.30	1.14 ± 0.35	**0.04**	**0.392**	**0.045**
Perineal Laceration	1.85 ± 0.35	1.85 ± 0.32	1.83 ± 0.33	**-0.02**	**0.685**	**-0.024**
Fetal Head Level	-0.11 ± 1.22	0.07 ± 1.32	-0.22 ± 0.94	**-0.15**	**0.103**	**-0.148**
Neonatal Parameters						
Neonatal Birth Weight (gr)	3222.02 ± 394.81	3164.15 ± 391.74	3359.62 ± 370.49	**195.47**	**0.004**	**0.270**
Neonatal Birth Height (cm)	50.36 ± 1.61	50.17 ± 1.65	50.79 ± 1.44	**0.62**	**0.007**	**0.251**
Ponderal Index	2.51 ± 0.20	2.49 ± 0.20	2.55 ± 0.18	**0.06**	**0.039**	**0.195**

Note: ALL: All primigravid pregnant, NGWG: Normal gestational weight gains primigravid pregnant, HGWG: High gestational weight gain primigravid pregnant, Δ: Delta difference between groups, p: statistically significant $p < 0.05$, r_B : Rank-Biserial Correlation, min: minute, gr: gram, cm: centimetres



Note: Light-coloured bars represent women with normal gestational weight gain primigravid pregnant, while dark-coloured bars represent high gestational weight gain primigravid pregnant women. The straight line represents the significance between groups. Statistical significance is indicated by an asterisk (*p <0.05). NGWG: normal gestational weight gain, HGWG: High gestational weight gain,

Figure 3. a. Labor Time, **b.** Ponderal Index, **c.** Neonatal Birth Weight, **d.** Neonatal Birth Height

Discussion

The aim of the study was to investigate the effects of weight gain during pregnancy on birth parameters and sleep quality in primigravid women. As far as we know, this is the first study to comparatively analyse birth parameters and sleep quality in groups of pregnant women of normal and excessive weight according to ACOG criteria. The main finding of the study is that high weight gain during pregnancy (16 kg and above) compared to the normal weight gain group may be linked to increased physical inactivity, impaired sleep quality, prolonged active labor time, and an increase in the baby's ponderal index value. From a holistic perspective, our findings indicate that weight management is critical for a healthy pregnancy and birth outcome.

Weight Gain and Physical Inactivity in Primigravid Pregnant Women

Based on our findings, although the pre-pregnancy BMI values of both groups were similar, it was determined that the HGWG group had significantly higher pre-birth BMI values and daily sitting times. Furthermore, a nonsignificant numerical decrease in walking time was also observed ($p = 0.056$). There is a strong relationship between excessive weight gain during pregnancy and a decrease in physical activity [38,55–57]. Smith et al. (2014) indicated that increased body weight during pregnancy restricted mobility, leading women to a more sedentary lifestyle. In our findings, the high level of sitting time/sedentary behaviour in the primigravid HGWG group indicates that the basic mobility of pregnant women may be restricted and, as a result, they remain more passive during the rest of the day, combined with sitting [58]. This situation is seen as a risk factor that further increases weight gain.

Weight gain - Sleep Quality

Each kilogram of weight gain during pregnancy in primigravid women is associated with poor sleep quality, according to our study. In all groups, the rate of poor sleep quality was 71.29%, while in the HGWG group, this rate rose to 85.19%. In contrast, data from the American College of Obstetricians and Gynaecologists (ACOG) indicates that an increase of one kilogram in the weight of the fetus above the 16-kilogram threshold, as observed in primigravida pregnancies, is associated with a 3.68 percent reduction in the quality of sleep. This should be considered a factor that could also affect circadian rhythms, which are an important element of the general health of pregnant women. Sleep and metabolic regulation are closely interconnected through activation of the Hypothalamic–Pituitary–Adrenal Axis in both pregnant and non-pregnant individuals [59,60]. Disturbances in sleep patterns may lead to dysregulation of this neuroendocrine system and increased secretion of Cortisol, which plays

a critical role in glucose metabolism and energy balance. Elevated cortisol levels may also disrupt Circadian Rhythm, thereby affecting the normal sleep–wake cycle and contributing to further deterioration in sleep quality. In addition, sleep restriction has been associated with alterations in appetite-regulating hormones, including increased Ghrelin and decreased Leptin levels. These hormonal changes may increase appetite, promote caloric intake, and contribute to excessive gestational weight gain. Therefore, impaired sleep quality during pregnancy may influence maternal metabolic homeostasis through neuroendocrine pathways, potentially affecting both maternal weight regulation and pregnancy outcomes [61–63].

Tang et al. reported a correlation between excessive weight gain in pregnant women and sleep apnoea, snoring, and frequent awakenings [64,65]. In another study, it was concluded that excessive weight gain during pregnancy may trigger the development and/or worsening of sleep disturbances during this period [66]. Yang et al. demonstrated that weight gain affects sleep quality based on data obtained from 223 pregnant women in Brazil. They reported that overweight women had poorer sleep quality compared to women with normal weight in both the second and third trimesters of pregnancy [67].

The results of this study support the findings of the extant literature on the subject, as the sleep latency, sleep disorder, and daytime dysfunction scores were found to be significantly higher in the HGWG group. In primigravid pregnancies, factors such as weight-gain-induced airway narrowing, increased metabolic load, and anatomical shifts—like diaphragmatic pressure—can hinder the transition to deep sleep and disrupt overall sleep continuity.

Birth and Neonatal Parameters

Examination of the findings related to the birth parameters in our study indicates that the active labor period was significantly longer ($p = 0.047$) in primigravid women with high weight gain. As reported in previous studies, the duration of labor is increased in obese pregnant women [58,68], and pre-pregnancy obesity may further prolong labor and increase the risk of maternal and neonatal complications during delivery [69–71], with similarly protracted deliveries reported elsewhere in the literature [71]. In another study, Carlhäll et al. (2024) proposed that excessive gestational weight gain may have a detrimental effect on uterine contractility and that soft tissue adiposity may contribute to a prolonged labor by creating resistance in the birth canal [70]. The present findings lend support to this theory and the extant literature on the subject.

A subsequent examination of neonatal values revealed that the birth weight, length, and ponderal index values of infants in the HGWG group were found to be significantly higher than those in the NGWG group. A high ponderal index may indicate that the baby's weight is excessive for its length, i.e., asymmetric macrosomia [72]. Kominiarek et al. (2019) reported that excessive weight gain stimulates fetal insulin-like growth factors, leading to neonatal macrosomia. In our study, the HGWG group had high ponderal index values, suggesting that excessive weight gain may be related to fetal adiposity [73]. Although adipose tissue plays an important role in neonatal energy reserves and thermoregulation, excessive and irregular distribution of fetal adipose tissue may reflect an adaptation to a restrictive intrauterine environment and may predispose the child to long-term metabolic and health problems [74]. Furthermore, excessive gestational weight gain has been associated with epigenetic alterations that may influence fetal development and increase the risk of metabolic diseases later in life [75]. Therefore, maintaining an appropriate balance of weight gain during pregnancy is of great importance. Disruption of this balance may lead to adverse effects on both the mother and the fetus.

Limitation

The study was conducted at a single centre, which may limit its generalizability to the entire primigravid pregnant population in different socio-cultural and geographical regions. In addition, although the overall sample exceeded the total size indicated by the a priori power analysis, the HGWG (n = 54) did not reach the per-group target of 64 participants; comparisons involving this group should therefore be interpreted with some caution regarding statistical power. Moreover, only women who achieved a vaginal delivery were eligible for inclusion; women who required a caesarean section, potentially including those with more severe consequences of excessive weight gain, were excluded. This selection criterion may have biased the labor-duration and delivery-related comparisons toward participants with less complicated deliveries and should be considered when generalizing the findings. Furthermore, factors such as dietary habits and stress levels, which can directly affect the sleep quality and weight gain of pregnant women, have not been evaluated. Additionally, the IPAQ-SF and PSQI were administered at hospital admission after the onset of labor rather than earlier in pregnancy; retrospective reports of the preceding week's activity and the preceding month's sleep may therefore have been influenced by the acute pain and stress of active labor, and the cross-sectional timing of these measurements relative to gestational weight gain precludes any causal interpretation of the observed associations. Future studies may evaluate nutrition and stress-

controlled methods, administer these questionnaires at multiple time points across pregnancy, and use multicentre and larger populations.

Conclusions

The findings of this study indicate that adherence to the weight gain limits recommended by the ACOG in primigravid pregnancies may help prevent clinical conditions that could pose risks during the gestational period. In addition, these findings imply that controlled weight gain may contribute to maintaining optimal sleep hygiene and supporting the physiological process of childbirth. Furthermore, they highlight that these guidelines may serve as a contributing element in maintaining the infant's physical parameters within healthy levels. Finally, we would like to draw attention to the need for awareness programs on “weight gain during the first pregnancy and the associated risks”.

List of Abbreviations

ACOG: American College of Obstetricians and Gynecologists; BMI: Body Mass Index; CI: Confidence Interval; FDA: Food and Drug Administration; GWG: Gestational Weight Gain; HGWG: High Gestational Weight Gain; HPA: Hypothalamic-Pituitary-Adrenal; IOM: Institute of Medicine; IPAQ-SF: International Physical Activity Questionnaire - Short Form; LMP: Last Menstrual Period; NGWG: Normal Gestational Weight Gain; PSQI: Pittsburgh Sleep Quality Index; WHO: World Health Organization.

Declarations

Ethics approval and consent to participate

The study was approved by the Clinical Research Ethics Committee of Manisa Celal Bayar University (approval date 30 July 2025; reference number 20/478/486/3344). The study was conducted in accordance with the Declaration of Helsinki. All participants were informed about the objectives of the study and provided written informed consent to participate, including separate written consent for access to their electronic medical records.

Consent for publication

Not applicable. This manuscript does not contain any individual person's identifiable data (details, images, or videos).

Availability of data and materials

The dataset generated and analysed during the current study, in which participants' identifying information has been coded to ensure anonymity, is available in the Figshare repository: https://doi.org/10.6084/m9.figshare.32594319.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MO and ND conceived and designed the study. MO, DUK and EU acquired the data. EU, EG and ND performed the statistical analysis. SDY and ND interpreted the results. MO, ND and SDY drafted the manuscript, and EG and DUK critically revised it for important intellectual content. All authors read and approved the final manuscript.

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