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The Effect of Daily Sitting Duration in Pregnant Women with Healthy and Chronic Diseases on Sleep Quality, Birth and Neonatal Parameters

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Article

Keywords: Chronic disease pregnancy, Daily sitting time, Labor, Neonatal parameters, Third trimester

Posted Date: April 28th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9333189/v1

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Additional Declarations: No competing interests reported.

Abstract

This study aimed to compare differences in sleep quality, as well as maternal and neonatal parameters, associated with daily sitting time (ST) between pregnant women with chronic diseases (CDP) and healthy pregnant (HP) women. Following an initial screening, 102 participants (51 CDP and 51 HP) in their 36th to 42nd week of pregnancy were included. Both groups were categorized into three subgroups based on daily sitting duration: short, and long. Sleep quality, maternal birth parameters, and neonatal birth parameters were measured for all groups. The ANCOVA test was used to determine main effects and covariate factors based on sitting levels and disease status. Neonates of mothers with low sitting levels have significantly higher hemoglobin levels ($p < 0.001$). The PI index of the neonate was negatively affected by increased sitting time [$r(98) = -0.200$, $p = 0.044$]. As sitting time increased, daytime dysfunction increased in chronic pregnant women [$r(98) = 0.216$, $p = 0.030$]. Prolonged sitting in the third trimester may be a potential risk factor with adverse effects on healthy and chronic disease pregnant women and their children. These findings may serve as a reference for experts to adjust the balance between physical activity and sitting in pregnant women.

1. Introduction

Sitting time is one of the most important indicators of a sedentary lifestyle. It is known that ST and sedentary lifestyle behaviours increase in women, especially during pregnancy. As the due date approaches to birth, increased body weight, some psycho-logically based anxieties, and protective behaviours toward the birth lead to the adoption of a more sedentary lifestyle. The literature frequently discusses the benefits of physical activity and regular exercise during the first and second trimesters of pregnancy for maternal and fetal health (1–3). Numerous experimental studies and meta-analyses have attempted to explain the positive contributions of physical activity based on physiological foundations. However, the undeniable reality of increased mobility limitations in the third trimester poses a barrier to physical activity levels. Studies have also shown that this period is when the lowest physical activity levels are observed among the trimesters (4, 5). This low level of physical activity increases mortality from all causes in normal indi-viduals, particularly cardiovascular mortality and type 2 diabetes incidence. However, the effects of prolonged sitting on pregnant women in the third trimester remain unclear (6, 7). Furthermore, the lack of exercise-based research specific to the third trimester limits our understanding of the potential birth-related effects of prolonged sitting during this period.

Chronic disease (CD) in pregnancy defined as conditions as according to whether they lasted 12 months or longer and (8) limited independent living, social interactions, or self-care or (9) required ongoing intervention with medical services, products or equipment and being recognized and treated for 3 months or more prior to pregnancy, requiring medical attention or medication, and known to be persistent, incurable, and may worsen over time. CD related with mortality and morbidity in pregnancy. The most included conditions are hypertension, diabetes, thyroid diseases, epilepsy, asthma, rheumatoid arthritis, mental health conditions and malignancy. CDP generally expe-rience a decrease in their level of physical activity throughout pregnancy. This situation can be attributed to various factors, such as symptoms related to the diseases, concerns about potential risks, and doctor's recommendations. A study examined physical activity and sedentary lifestyles among pregnant women with gestational diabetes mellitus (GDM). As a result, it was found that a large proportion of women with GDM sitting time for more than 6 hours a day and had a low compliance rate with exercise (10). Another study highlights the difficulties experienced by CDP and their concerns regarding physical activity and exercise. It has been found that most CDP are less physically active due to fears of harming both their own health and that of their baby (11). During pregnancy, processes such as sleep are also affected within the daily life cycle. Decreased levels of physical activity in CD are more likely to encounter sleep difficulty and have a reduced Health-Related Quality of Life, but there is little research on their possible mechanisms (12). In one study; they found out that increased physical activity levels have been associated with better sleep quality (13).

Unfortunately, there are no studies observing the relationship between sedentary behaviours (particularly prolonged sitting) in the third trimester of chronic patients and maternal-child processes during and after childbirth. Given that this is the period closest to delivery, identifying the implications of sitting-related behaviours on maternal-child health through a specific approach to this period may be important from a health perspective.

In light of the information presented above, the aim of our study is to reveal the effects of sitting duration on sleep quality, birth and neonatal parameters in healthy and chronically diseases pregnant women between 36 and 42 weeks of gestation.

2. Materials and Methods

2.1.Participants

The sample size and statistical power were calculated using G*Power (v3.1.9.7) software. Initially, a minimum of 90 participants (45 per group) was targeted to achieve sufficient power. However, the study was completed with 102 pregnant women (36–42 weeks of gestation) to enhance the robustness of the findings. Participants were primarily categorized into two groups based on their health status: those with Chronic Disease (CD; n = 51) and Healthy Pregnancies (HP; n = 51). Following this, these groups were further classified based on their daily Sitting Time (ST), as assessed by the IPAQ questionnaire. Using a median split of 450 minutes/day, participants were divided into Low Sitting Time (n = 54) and High Sitting Time (n = 48) groups. This cross-sectional, observational design (Fig. 1) utilized a two-way ANCOVA model (Health Status / Sitting Time) with three covariates (age, weight change, and number of pregnancies).Post-hoc power analysis confirmed that with n = 102, an alpha error of 0.05, and a medium effect size (f = 0.25) at 95 degrees of freedom (df = 95), the statistical power was 0.73. For a medium-high effect size (f = 0.30), the power reached 0.87, meeting the conventional threshold of 0.80 (14). These participant flow diagram represented to Fig. 1 .

2.3.Study Design and Participants

A cross-sectional observational study was performed at a single secondary care obstetrics centre. Data were collected between November 2025 and February 2026, with participants categorized based on pre-existing health conditions and self-reported sedentary behaviour. All participants have declared that they participated in the study voluntarily. Additionally, these participants were informed of the study objectives and provided their voluntary consent to participate, by signing consent to participate in the survey in the questionnaire and consent for access to medical records (it was one of the inclusion criteria). The parents were informed that getting involved in the research would not influence their neonatal diagnostic and therapeutic process and that the neonatal would not be exposed to additional process. Pregnants were invited to the study during their stay in the obstetric unit after delivery. The neonatal's parents had informed and asked to have they have any questions about survey. Each neonatal and pregnant women included in the study were given an identification number, depending on data from the medical recordings (such as mode of labor, duration of pregnancy, cervical dilatation, fetal head level and labor induction). Neonatal parameters; fetal birth weight, height, APGAR score, neonatal glucose and hemoglobin parameters were measured after labor completed. Measurements of anthropometric (weight and height) data of the pregnant were taken when pregnant presented for delivery and maternal weight gain during pregnancy was calculated. We used a questionnaire consisting of self-reported questions in the form of a medical interview and get Physical Activity Questionnaire Short Form (IPAQ-SF) and Pittsburgh Sleep Quality Index (PSQI). In the second stage we analysed electronic medical data recordings.

2.3.1.Inclusion and Exclusion Criteria

The study population comprised pregnant women aged 20–35 years with no mental or cognitive impairments, capable of completing questionnaires independently, and who had a spontaneous vaginal delivery between 36 and 42 weeks of gestation. Exclusion criteria included multiple pregnancies, fetal malpresentation, and placental complications, such as placenta accreta spectrum or placenta previa. Additionally, patients with intrauterine growth restriction, polyhydramnios, hypertensive disorders of pregnancy (pre-eclampsia/eclampsia), orthopaedic or neurological diseases, and a history of uterine surgery or caesarean section were excluded from the study.

2.3.2.Bias

To make the study more reliable, we checked the information on the questionnaires against the patient's electronic medical data recordings. This allowed us to minimize potential errors due to participant recall or subjective assessment.

2.4.Data Collection Tools

The demographic and clinical characteristics of the women were obtained from the medical records and from the questionnaire included questions about systemic diseases, e.g., respiratory, cardiovascular, epilepsy, diabetes, thyroid disease, eating disorders, anaemia, chronic hypertension etc. The gestational age of the participants was evaluated by using the last menstrual period and ultrasonography findings that were performed before 20 weeks of gestation. The questionnaire is divided into three parts—the first is a self-administered questionnaire on socio-demographic factors, previous obstetric history, and antenatal care. In the second part, the patients answered questions from the Turkish version of the get International Physical Questionary Short Form (14–15). In the third part, the sleep quality was evaluated using the Turkish version Pittsburgh Sleep Quality Index (PSQI) (16).

2.4.1.Sitting Duration Assessment

IPAQ-SF was also utilized to evaluate the daily ST of pregnant women. The literature indicates that the impact of ST on maternal and neonatal parameters may be more significant than that of physical activity intensity and duration. Therefore, the ST section of the IPAQ-

SF, which has been used in previous studies with pregnant women, was employed to assess the ST of participants between 36 and 42 weeks of gestation during the final week before delivery. The Turkish version of the scale has been validated as a reliable tool for assessing physical activity and, in particular, its subcategory “daily sitting time”. (17, 18).

2.4.3.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 (18). The PSQI is a 24-item questionnaire, with 19 items completed by the individual. 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 (19).

2.5.Maternal Variables

2.5.1.Episiotomy and Perineal Laceration

Episiotomy, the surgical incision of the perineum to enlarge the vaginal outlet at the time of fetal delivery. There is well documented decreased risk associated with its use, including excessive blood loss, wound dehiscence, infection, short- and long-term perineal pain, and decreased risk of severe lacerations in deliveries (20). Perineal laceration is uncontrolled perineal muscle tear in postpartum women. Severe lacerations, particularly obstetric anal sphincter injuries, can lead to significant complications like pelvic floor dysfunction and incontinence (21).

2.5.2.Labor Duration, Cervical Dilatation, Fetal Head Level and Labor Induction

The active phase of labor was defined as the period during which cervical dilation progresses from 5 cm. (centimetres) to complete dilation at 10 cm. The second phase of labor was defined as the period from complete cervical dilation until the actual birth of the baby. The third phase of labor was defined as the time from the birth of the baby until the delivery of the placenta and its associated membranes (8). In this research we used labor duration as active phase of labor. Assessment of the fetal head level made when pregnant women presented for delivery by vaginal examination; The level of fetal presentation in the birth canal is defined by the relationship to the spina ischiatic, which are located midway between the pelvic inlet and outlet. A value of -3/+3 is given on the partograph according to the distance to the ischial spinae. Induction of labor is the stimulation of labor by ripening the cervix and uterine contractions with external agents after the onset of spontaneous labor to achieve vaginal delivery (22).

2.6.Neonatal Variables

2.6.1.Fetal Birth Weight, Height, Fetal Head Level and Neonatal Ponderal Index

The birth weight of the neonatal measured after 1 hour later using a valid balanced SECA® 354 (Hamburg, Germany) birth weight scale (23). The scale checked and zeros after measuring each newborn child. Neonatal birth weight in the literature, the breakdown of neonates by birth weight is as follows (24, 25): Low birth weight: 1500–2499 gr (gram), Normal birth weight: 2500–3999 gr, Macrosomia: >4000 gr. Birth weight-for-GA (Gestational Age), length-for-GA (26). Based on Fenton’s intrauterine growth chart, infants were categorized as small-for-GA (SGA) or large-for-GA (LGA) if their birth weight for GA was below the 10th or above the 90th percentile, respectively.

Ponderal index was calculated as Birth Weight (gr) / Length (cm)3 × 100. Neonates with a ponderal index below 2.32 gr / cm3 or above 2.85 g/cm3 were classified as thin or obese, respectively (27, 28, 29).

2.6.2.APGAR Score, Neonatal Glucose and Hemoglobin Parameters

The APGAR score allows a quick assessment of the baby’s condition after birth without 100% interfering with the infant’s care (30). We gave 0 to 2 points in 5 categories: fetal heart rate, respiration, response to stimuli, muscular tension and skin colour. Assessments were made at first and fifth minutes of the baby’s life (31). A score above seven indicated the proper condition of the infant. Neonatal glucose levels measured after birth before without maternal breast feeding by using Nova Statstrip® (Nova Biomedical, Waltham, MA, USA) glucometer (32). Hypoglycaemia refers to blood glucose levels dropping below 45 mg/dL in newborns. Hyperglycaemia, on the other hand, refers to elevated blood glucose levels, above 120 to 150 mg/dL in newborns. For the neonatal hemoglobin (Hb) measurement; capillary samplings were obtained after birth within the 1 hours by the heel prick technique using a neonatal lancet (1 mm × 2.5 mm).

Afterwards having wiped off the first two drops of blood (defining a volume of 0,05 ml per drop) (33), the subsequent 20 drops (total volume of 1 ml) were collected into a blood tube containing ethylenediaminetetraacetic acid for measuring Hb. Neonatal Hb measurements were obtained using a haematology analyzer (Siemens Advia 2120, Siemens, Munich, Germany). Only one result per baby was included to eliminate any bias from individuals. At birth neonatal hemoglobin levels are 12.2–23.2 g/dL in term neonates (34).

2.7.Statistical Analysis

All statistical analyses of the data obtained in the study were performed using JASP software (version 0.19.2). Participants were divided into two groups based on the median value of daily sitting time (450 minutes): Low Sitting Time (n = 54) and High Sitting Time (n = 48). To determine differences between groups regarding continuous maternal and child-related variables, a two-way Analysis of Covariance (ANCOVA) was applied, with age, weight change, and number of pregnancies included as covariates (35). The analysis evaluated maternal variables (sitting time, total PSQI score and sub-parameters, labor time, fetal head level) and child-related parameters (birth height and weight, hemoglobin, blood sugar, Apgar and PI scores) (36). The homogeneity of variances, a fundamental assumption of ANCOVA analysis, was verified using the Levene test, while the homogeneity of regression slopes was verified using the relevant interaction terms. For categorical outcomes, such as labor induction, episiotomy, and perineal laceration, the Pearson Chi-square (X^2) test was utilized to ensure methodological validity for nominal data. To preserve the Type I error rate, Bonferroni correction was applied for pairwise comparisons of statistically significant main effects or interactions. Relationships between variables were assessed using Pearson correlation analyses, and effect sizes were determined as small (0.2), medium (0.5), and large (0.8). For categorical outcomes, such as health status (Healthy vs. Chronic), Binary Logistic Regression was utilized instead of ANCOVA to ensure methodological validity for nominal data. Additionally. Multiple Linear Regression Analysis was conducted to identify predictors of sitting duration. In this model, unstandardized coefficients (β) were reported to indicate the absolute change per unit, while standardized coefficients (β) were used to compare the relative predictive strength of each variable (37). A $p < 0.05$ level of statistical significance was accepted in all analyses.

3. Results

3.1. Maternal Individual Characteristics

The mean age of the 102 pregnant women included in the study was 26.36 ± 5.60 years, their mean height was 160.43 ± 16.55 cm, and their mean body weight was 78.05 ± 13.77 kg. These pregnant women were divided into two groups based on calculated a median daily sitting time of 450 minutes: Low Sitting Time (n = 54) and High Sitting Time (n = 48). The mean age of the group with low sitting time was 26.74 ± 5.31 years, their height was 161.51 ± 9.84 cm, and their body weight was 77.48 ± 14.26 kg, while the group with high sitting duration had an average age of 25.93 ± 5.93 years, height of 159.20 ± 21.83 cm, and body weight of 78.68 ± 13.32 kg.

3.1.Sitting Duration

The results of the ANCOVA analysis, which controlled for the effects of age, number of pregnancies, and weight change in pregnant women, a statistically significant difference was found between the groups in terms of sitting time; $F(1, 95) = 292.30$, $p < 0.001$, $n^2_p = 0.755$. However, no significant effect of the covariate variables (age, number of pregnancies, and weight change) on sitting time was detected ($p > 0.05$). Bonferroni-adjusted Post-Hoc analysis results showed that the group with a high level of sitting had a longer sitting duration (Δ= -431.39 min, $p < 0.001$).

3.3.Maternal Parameters According to Sitting Duration

The maternal parameters result of the ANCOVA analysis controlling for the effects of age, number of pregnancies, and weight change in pregnant women are presented below (see Table 1 for maternal sleep parameters mean values). In this analysis model, covariate parameters (age, weight change, and number of pregnancies) were defined. Additionally, the relationship between daily sitting duration groups and labour induction, Episiotomy and perineal laceration categorical values were analysed using the chi-square test for independence.

3.3.1.Labor Time

The statistically significant difference was not found between the sitting groups (SSL-LSL) in terms of labor time; $F(1, 96) = 0.73$, $p = 0.396$, $n^2_p = 0.008$. However, a statistically significant difference was found in terms of health status; $F(1, 96) = 5.63$, $p = 0.020$, $n^2_p = 0.055$. Nevertheless, one of the covariate variables, number of pregnancies, had a significant effect on labor time $F(1, 96) = 8.10$, $p = 0.005$, $n^2_p = 0.078$. In the Bonferroni-corrected Post-Hoc analysis results, longer labor time (Δ = -24.80 min, $p = 0.020$) was found in the chronic disease group.

3.3.2.Fetal Head Level

In the results of the fetal head level is no statistically significant difference was found between the sitting groups (SSL-LSL) in regard to head level; $F(1, 96) = 1.036$, $p = 0.311$, $n^2_p = 0.011$. The covariate variables were also found to have no significant effect on fetal head level ($p > 0.05$). The results of the Bonferroni-corrected Post Hoc test also confirm that there is no significant difference between the sitting groups in terms of head level ($\Delta = 0.209$, $p = 0.311$).

3.3.3.Labor Induction

In the results of the labor induction is no statistically significant relationship between sitting duration and labour induction, $X^2(1, N = 102) = 1.32$, $p = 0.251$. Specifically, the rate of labour induction was 44.4% (n = 24) in the low sitting time group, while it was 33.3% (n = 16) in the high sitting time group.

3.3.4.Episiotomy

In results of the episiotomy is not statistically significant relationship between sitting duration and the occurrence of episiotomy, $X^2(1, N = 102) = 0.41$, p = 0.523. Specifically, the rate of episiotomy was 31.5% (n = 17) in the low sitting time group, whereas it was 37.5% (n = 18) in the high sitting time group.

3.3.5.Perineal Laceration

The result of the episiotomy is no statistically significant relationship between sitting duration and perineal lacerations,, X^2 (1, $N = 102$) = 1.07, $p = 0.302$. Specifically, the rate of perineal lacerations was 81.5% (n = 44) in the low sitting time group, while it was 72.9% (n = 35) in the high sitting time group.

Table 1
Mean Values of Maternal Parameters According to Sitting Level

Sitting Level	Participants	Sitting Time (min)	Pregnancy Parities	Pregnancy Week	Body Weight Change (kg)	Labor Time (min)	Fetal Head Level	Labor Induction	Episiotomy	Perineal Laceration
Short	Healthy (n = 27)	271.67 ± 127.57	1.44 ± 0.51	39.22 ± 1.04	11.00 ± 4.81	85.00 ± 48.82	0.52 ± 1.01	1.37 ± 0.48	1.38 ± 0.47	1.89 ± 0.31
	Chronic (n = 27)	270.83 ± 128.87	1.66 ± 0.47	39.00 ± 1.30	12.15 ± 4.81	103.33 ± 71.01	0.12 ± 1.11	1.46 ± 0.50	1.29 ± 0.48	1.82 ± 0.38
Long	Healthy (n = 24)	705.00 ± 124.25	1.67 ± 0.48	39.13 ± 1.26	10.13 ± 3.89	71.46 ± 26.67	0.16 ± 0.855	1.38 ± 0..49	1.48 ± 0.50	1.84 ± 0.37
	Chronic (n = 24)	705.00 ± 124.25	1.46 ± 0.52	39.25 ± 1.07	14.58 ± 4.82	102.29 ± 44.90	0.08 ± 1.06	1.32 ± 0.47	1.28 ± 0.49	1.63 ± 0.48

Note: min: minute, kg: kilograms

3.4.Sitting Duration and Maternal Sleep Parameters

The maternal sleep parameters result of the ANCOVA analysis controlling for the effects of age, number of pregnancies, and weight change in pregnant women are presented below (see Table 2 for maternal sleep parameters mean values). In this analysis model, covariate parameters (age, weight change, and number of pregnancies) were defined.

3.4.1.PSQI Score

There is not statistically significant difference was found between the sitting groups (SSL-LSL) in regard to PSQI score; $F(1, 96) = 0.168$, $p = 0.683$, $n^2_p = 0.002$. However, a statistically significant difference was found in terms of health status $F(1, 96) = 10.26$, $p = 0.002$, $n^2_p = 0.097$. However, the number of pregnancies, one of the covariate variables, did not have a significant effect on the PSQI score ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis results, it was observed that the group with chronic disease had higher PSQI scores ($\Delta = -2.099$, $p = 0.002$).

3.4.2.Sleep Duration

There is not statistically significant difference was found between the sitting groups (SSL-LSL) in terms of sleep duration; $F(1, 96) = 0.168$, $p = 0.683$, $n^2_p = 0.002$. The covariate variables did not have a significant effect on sleep duration ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis results, no significant difference was found between the sitting groups (SSL-LSL) in terms of sleep duration ($\Delta = -0.114$, $p = 0.507$).

3.4.3.Sleep Efficiency

The is not statistically significant difference was found between the groups in terms of sleep efficiency score; $F(1, 96) = 1.343$, $p = 0.249$, $n^2_p = 0.014$. The age variable included in the model had a significant effect on the sleep efficiency score $F(1, 96) = 5.750$, $p = 0.018$, $n^2_p = 0.057$. In the Bonferroni-corrected Post-Hoc analysis results, a higher sleep efficiency score ($\Delta = 0.523$, $p = 0.005$) was detected in the group with chronic disease.

3.4.4.Sleep Disturbance

There is not significant difference was found between the sitting groups (SSL-LSL) in terms of sleep disturbance score; $F(1, 96) = 0.052$, $p = 0.821$, $n^2_p < 0.001$. The covariate variables did not have a significant effect on the sleep disturbance score ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis results show ; no significant difference in the sleep disturbance score between the sitting groups (SSL-LSL) ($\Delta = 0.04$, $p = 0.821$).

3.4.5.Sleep Latency

There is not statistically significant difference was found between the sitting groups (SSL-LSL) in terms of sleep latency value; $F(1, 96) = 0.282$, $p = 0.597$, $n^2_p = 0.003$. However, chronic disease has an effect on sleep latency $F(1, 96) = 13.329$, $p < 0.001$, $np2 = 0.122$. None of the covariate variables had a significant effect on sleep latency ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis results, it was determined that pregnant women with chronic diseases had higher scores in terms of sleep latency ($\Delta = -1.217$, $p < 0.001$).

3.4.6.Subjective Sleep Quality

There is not statistically significant difference was found between the groups in terms of subjective sleep quality and sitting time; $F(1, 96) = 0.037$, $p = 0.847$, $n^2_p < 0.001$. The covariate variables did not have a significant effect on subjective sleep quality ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis shows; there is no significant difference was found between the sitting groups (SSL-LSL) in terms of subjective sleep quality ($\Delta = 0.28$, $p = 0.847$).

3.4.7.Daytime Dysfunction

There is not statistically significant difference was found between the sitting groups (SSL-LSL) in terms of daytime dysfunction scores; $F(1, 96) = 1.616$, $p = 0.207$, $n^2_p = 0.017$. However, chronic disease had an effect on daytime dysfunction scores $F(1, 96) = 18.989$, $p < 0.001$, $n^2_p = 0.165$. None of the covariate variables had a significant effect on daytime dysfunction score ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis results, it was determined that pregnant women with chronic diseases had higher values in terms of daytime dysfunction ($\Delta = -0.736$, $p < 0.001$).

Table 2
Maternal Sleep Parameters

Sitting Level	Participants	PSQI Score	Sleep Duration	Sleep Efficiency	Sleep Disturbance	Sleep Latency	Subjective Sleep Quality	Daytime Dysfunction
Short	Healthy (n = 27)	5.96 ± 1.81	0.37 ± 0.79	0.96 ± 1.06	1.33 ± 0.73	1.63 ± 0.88	1.26 ± 0.76	0.19 ± 0.48
	Chronic (n = 24)	8.25 ± 3.92	0.52 ± 0.89	0.44 ± 0.80	1.63 ± 0.84	2.74 ± 2.05	1.52 ± 0.80	1.11 ± 1.01
Long	Healthy (n = 27)	8.50 ± 3.55	0.29 ± 0.69	0.75 ± 0.99	1.29 ± 0.81	1.17 ± 0.56	1.17 ± 0.56	0.54 ± 0.66
	Chronic (n = 24)	5.48 ± 2.86	0.42 ± 0.88	0.33 ± 0.70	1.58 ± 0.65	1.58 ± 0.78	1.58 ± 0.78	1.17 ± 1.01

Note: PSQI: Pittsburgh Sleep Quality Index

3.5.Neonatal Parameters

The neonatal parameters result of the ANCOVA analysis controlling for the effects of age, number of pregnancies, and weight change in pregnant women are presented below (see Table 3 for maternal sleep parameters mean values). In this analysis model, covariate parameters (age, weight change, and number of pregnancies) were defined.

3.5.1.Neonatal Birth Weight

In the results of the neonatal birth weight is not statistically significant difference was found between the sitting groups (SSL-LSL) in terms of sitting duration on neonatal birth weight; $F(1, 96) = 0.073$, $p = 0.788$, n^2_p <0.001. None of the covariate variables had a significant effect on neonatal birth weight (p > 0.05). In the Bonferroni-corrected Post-Hoc analysis results, no significant difference was found between the sitting groups (SSL-LSL) in terms of neonatal birth weight (Δ = 23.062, $p = 0.788$).

3.5.2. Neonatal Birth Height

In the results of the not statistically significant difference was found between the sitting groups (SSL-LSL) in terms of sitting duration on neonatal birth height; $F(1, 96) = 0.810$, $p = 0.370$, $n^2_p = 0.008$ The covariate variables did not have a significant effect on neonatal birth height ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis results; no significant difference was found between the sitting groups (SSL-LSL) in terms of neonatal birth height (Δ = 0.405, $p = 0.370$).

3.5.3. Neonatal Hemoglobin

In the results of the neonatal hemoglobin a statistically significant difference was found in neonatal hemoglobin values between the sitting groups (SSL-LSL) in terms of sitting duration; $F(1, 96) = 12.168$, $p < 0.001$, $n^2_p = 0.112$ The covariate variables did not have a significant effect on neonatal hemoglobin levels ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis results; it was found that the hemoglobin levels of children of pregnant women with low sitting levels were significantly higher than the other group (Δ = 0.975, $p <$ 0.001).

3.5.4.Neonatal Blood Glucose

There is not statistically significant difference was found between the sitting groups (SSL-LSL) in terms of neonatal blood glucose levels based on sitting duration; $F(1, 96) = 0.424$, $p = 0.517$, $n^2_p = 0.004$ The covariate variables also did not have a significant effect on neonatal blood glucose levels ($p > 0.05$). In the Bonferroni-corrected Post-Hoc analysis results, no significant difference was found between the sitting groups (SSL-LSL) in terms of neonatal blood glucose value (Δ = 3.088, $p = 0.517$).

3.5.5. Apgar Score

In the results of the Apgar not statistically significant difference was found between the sitting groups (SSL-LSL) in terms of Apgar score; $F(1, 96) = 0.944$, $p = 0.334$, $n^2_p = 0.010$. The covariate variables did not have a significant effect on the Apgar score ($p > 0.05$).

3.5.6. PI Score

There is no statistically significant difference was found between the sitting groups (SSL-LSL) in terms of neonatal PI score based on sitting duration; $F(1, 96) = 2.626$, $p = 0.108$, $n^2_p = 0.028$ .The covariate variables did not have a significant effect on the PI Score ($p > 0.05$). In the Bonferroni-adjusted Post-Hoc analysis results; no significant difference was found between the sitting groups (SSL-LSL) in terms of neonatal PI score ($\Delta = 0.11$, $p = 0.108$).

Table 3
Neonatal Parameters

Sitting Level	Participants	Birth Weight (g)	Birth Height (cm)	Blood Glucose (mg/dL)	Haemoglobin (g/dL)	APGAR Score	PI Score
Short	Healthy (n = 27)	3.055.95 ± 414.71	49.74 ± 1.83	81.74 ± 41.27	18.34 ± 1.79	8.74 ± 1.83	2.63 ± 0.49
	Chronic (n = 24)	3390.30 ± 370.12	50.78 ± 2.78	74.48 ± 17.50	17.58 ± 0.86	9.74 ± 0.90	2.63 ± 0.49
Long	Healthy (n = 27)	3179.20 ± 348.77	50.28 ± 1.95	63.32 ± 21.34	17.21 ± 1.28	8.88 ± 0.44	2.47 ± 0.15
	Chronic (n = 24)	3331.92 ± 578.89	50.79 ± 2.17	78.54 ± 8.74	17.04 ± 1.36	9.58 ± 0.83	2.48 ± 0.17

Note: g: gram, cm: centimetres, g/dL: gram/decilitres, mg/dL: milligram/decilitres

3.5. Correlation and Regression Analysis Related to Sitting Time

3.5.1. Relationships Between Sitting Duration and Sleep/Neonatal Parameters

The positive and low correlation [$r(98) = 0.216$, $p = 0.030$] was found between sitting duration and daytime dysfunction, a negative and moderate correlation [$r(98) = -0.402$, $p < 0.001$] was found between sitting duration and PI scores-children's hemoglobin levels, PI score [$r(98) = -0.200$, $p = 0.044$].

3.5.2. Relationships Between Sleep Parameters and Birth/Child parameters

A positive and low-level [$r(98) = 0.234$, $p = 0.018$] significant relationship was determined between the PSQI total score and induction rates. Additionally, negative and low-level [$r(98) = -0.206$, $p = 0.037$] significant relationship was determined between sleep duration and episiotomy rates.

3.5.3. The Regression Analysis of Sitting Duration

The multiple linear regression analysis confirmed the statistical significance of the model, $F(6, 95) = 4.26$, $p < 0.001$, $R^2 = 0.212$. The independent variables included in the model (Age, Number of Pregnancies, Weight Change, Daytime Dysfunction, Child Hemoglobin, and PI Score) accounted for approximately 21% of the variance in sitting duration. Regarding the regression coefficients, sitting duration was found to be a significant negative predictor of child hemoglobin levels ($B = -0.37$, $\beta = -0.37$, $t = -3.68$, $p < 0.001$) and PI scores ($B = -0.19$, $\beta = -0.19$, $t = -2.06$, $p = 0.043$). These results indicate that as sitting duration decreases, child hemoglobin levels and PI scores significantly increase. In contrast, sitting duration did not significantly predict age, number of pregnancies, weight change, or daytime dysfunction ($p > 0.05$).

4. Discussion

The study aimed to observe the effects of sitting duration on maternal and neonatal processes in healthy and chronically diseases pregnant women between 36 and 42nd. weeks of gestation. The main finding was that prolonged sitting negatively impacted neonatal hemoglobin and PI scores across all groups. Furthermore, for pregnant women with chronic diseases, increased sedentary time was directly linked to greater daytime functional impairment. These findings show a general trend that being physically active during the third trimester is a potential factor that could positively affect overall health and the child's development.

Sitting level has been found to have the most significant effect on hemoglobin levels in newborns. There was a significant increase in hemoglobin levels in the neonates of pregnant women with low sitting levels ($p < 0.001$). Correlation analysis also showed a negative and moderate relationship between sitting time and children's hemoglobin values [$r(98) = -0.402$, $p < 0.001$]. Meanwhile, regression results revealed that sitting duration had a predictive effect on children's hemoglobin levels ($p < 0.001$). Research in the literature indicates that increased circulation during physical activity positively contributes to neonatal circulation, consequently to the processes of nutrition and oxygenation (38, 39). On the other hand, it is known that physical inactivity and sitting times exceeding thirty minutes negatively affect circulatory functions and hematological values in pregnant women and their neonates. In one study excessive sitting time at 36th. weeks was found related with greater placental stiffness and lower umbilical artery pulsatilite index. They concluded that excessive sitting time may be a risk for suboptimal placental function (40). In a study conducted by Meander and colleagues in 2021, maternals weight gain during pregnancy, postpartum maternal blood loss, and birth weight parameters were examined according to sitting duration. While no significant difference was found in maternal weight gain, blood loss was lower in those with shorter sitting durations and not difference was found between sitting groups in terms of birth weight (41). In line with this study, we also found no significant difference between maternal weight gain and newborn weight based on sitting time in our study. Literature-based pregnant-neonatal hematological studies highlight that neonatal outcome was affected in newborns of chronically diseases pregnant women compared to HP (42). In one study, hematologic parameters of newborn babies of pregnant women with chronic hypertension and HP were compared and as a result in the CDP, neonatal white blood cells, neutrophils and platelets were found significantly lower than in the control group ($p < 0.05$) (42, 43). In the same study in chronic group neonatal hemoglobin (Hb) and hematocrit (Hct) level were found higher ($p < 0.05$). In another research, when comparing hemoglobin levels in children born to pregnant women with diabetes and those without diabetes, polycythaemia was seen in large numbers in newborns born too diabetic pregnant. On the other hand, the platelet counts and PCT values were significantly lower in newborns from diabetic pregnant than controls. Hb levels were found to be higher in children of diabetic pregnant (44, 45). These findings are consistent with those reported in the literatures. Our study findings indicate that reduced sitting time during the third trimester positively contribute to neonatal hemoglobin levels, a critical value in the development of the newborn baby. This conclusion is supported by our other findings, which show the highest PI score (2.71) and highest hemoglobin (18.65 g/dL) values in the babies of healthy pregnant women with short sitting times. Although neonatal hemoglobin levels are influenced by a multifactorial process, it has been suggested that reducing physical inactivity in pregnant women during the third trimester (especially those with chronic diseases pregnancy) may be considered a protective factor for neonatal hemoglobin levels. Future research is needed to investigate the possible physiological basis for this finding.

The increased sitting time negatively affected neonatal PI scores ($p = 0.044$), regardless of the specific health conditions within the pregnancy groups studied. The PI index is an index that accurately measures body composition development in infants (46). These changes in the index suggest that inactivity during the third trimester may be a factor contributing to disproportionate growth in the newborn. Previous studies indicate that physical activity during the third trimester—a period of rapid fetal growth—triggers positive circulatory, metabolic, and hormonal adaptations. These physiological mechanisms not only enhance maternal health but also provide critical support for fetal development (47–49). Our findings specifically indicate that these positive outcomes also extend to pregnancies complicated by chronic conditions, as observed in our study groups. These hemoglobin values support the hematological factors in terms of the PI value.

The results of our study revealed that daytime dysfunction increased as sitting time increased [$r(98) = 0.216$, $p = 0.030$]. Pregnant women with chronic diseases are known to have higher stress levels than HP during the period close to delivery (50). High stress levels can negatively affect certain life cycle processes. Some studies have associated this situation with factors such as low physical activity levels, sleep disorders and nutrition (51, 52). Our focus is on evaluating whether the daily sitting time during the third trimester, when mobility restrictions reach their highest level, close to delivery, could be a factor contributing to these negative outcomes. These results suggests that increased sitting duration is an additional factor in daytime function impairment. This finding indicates that, in addition to the negative effects of their disease, prolonged sitting increases daytime dysfunction in pregnant women with chronic diseases. Literature research show that women aged ≥ 30 years, 3rd trimester, multigravidas and chronic anaemic women during pregnancy were factors associated with poor sleep quality. The study finding revealed that there is a significant association between gestational age and sleep quality. This means that as pregnancy progresses, sleep quality tends to worsen. Therefore, women in the third trimester of

pregnancy have a higher chance of experiencing poor sleep quality, which is nearly three times higher than women in the first trimester (53). Another research suggests that sleep disorders may be associated with complications of pregnancy, such as gestational diabetes, gestational hypertension, preeclampsia, fetal growth disorders, preterm birth, and stillbirth (54, 55). Preexisting conditions such as asthma may be exacerbated by pregnancy-related physiologic changes such as upper airway congestion, heartburn, and immunologic changes (56). Another research showed that pregnancy excessive daytime sleepiness having incidence rate of chronic medical diseases were five times greater than for those women without chronic medical diseases. The possible clarification is the pain and fatigue of chronic medical diseases have impact on women daily activities including sleep quality. Because of their diseases they often experience sleeping problems at night, and they become sleepy during daytime (57). These findings and our results suggest that there is a need for strategies to reduce sitting time in all pregnant women, especially those with chronic conditions, during the third trimester. Long periods of sitting during the day may negatively affect daytime sleep-wake state (napping, dozing off) in third-trimester pregnant women, which may adversely affect nighttime sleep quality.

Limitations

Although the number of participants in the overall evaluation of the study is appropriate for our analysis, it is not possible to make general conclusions specific to the group. Specifically, we lacked the necessary number of participants in the subgroups and did not achieve the required balance to effectively stratify chronic diseases. Future studies require research involving large and evenly distributed participant groups, with subgroups separated by chronic disease type (such as diabetes, thyroid disease, etc.). Another limitation is that physical activity levels could not be monitored using participant-specific devices such as metabolic Holter monitors or pedometers.

5. Conclusions

Our findings reveal that prolonged sitting during the third trimester has the potential to cause adverse effects on maternal and child health, as demonstrated by numerous evidence-based studies in the general population. It was observed that the mother's daytime functional impairment, the newborn's PI index, and hemoglobin levels were directly affected factors in the emergence of harmful effects. We believe that clinicians should consider recommendations to reduce sitting time as an additional therapeutic factor alongside medical support for chronically ill pregnant women. On the other hand, we emphasize that clinicians and healthcare professionals such as exercise specialists should strike a careful balance between daily sitting time and physical activity during the third trimester and educate pregnant women on this matter to raise their awareness.

Abbreviations

The following abbreviations are used in this manuscript:

Cm: Centimetres

G. Gram

GDM : Gestational Diabetes Mellitus

Gr. Gram

Hb: Haemoglobin

Hct: Hematocrit

IPSAQ-SF: Physical Activity Questionnaire Short Form

PA: Physical Activity

PSQI: Pittsburgh Sleep Quality Index

Declarations

Institutional Review Board Statement

The study was conducted with the approval of the Manisa Celal Bayar University Health Sciences Ethics Committee, dated 30/07/2025, and numbered 20/478/486/3344. 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 their voluntary consent to participate, by signing consent to participate in the survey in the questionnaire and consent for access to medical records. The Trail Registration of Thai Clinical Trials Registry research system (TCTR20251028006–28.10.2025- Registered)

Informed Consent Statement: All participants declared that they participated in the study voluntarily. These participants were informed of the study objectives, and informed consent forms were distributed to and signed by all individual participants included in the study. This included voluntary consent to participate in the survey and consent for access to medical records.

Conflicts of Interest:

Conflicts of Interest: The authors declare no conflict of interest

Funding:

This research received no external funding

Author Contribution

Murat Ozsahin (M.O), Nurten Dinc (N.D), Erdem Uylas (E.U.) and Erkan Günay (E.G) designed the study. M.O., E.U., Duygu Ucar Kartal (D.U.K) and obtained the data. E.U. and Cagdas Guducu (C.G.) analysed the data. M.O.,N.D. E.U. and E.G interpreted the results and drafted the manuscript. E.G. supervised the study. All authors contributed to the review and revision of the manuscript and agree to be accountable for all aspects of the work, ensuring integrity and accuracy. All authors have read and agreed to the published version of the manuscript.

Data Availability

All relevant data are within the paper and its Supporting Information files. The minimal de-identified dataset underlying the results of this study has been deposited in the Figshare repository and can be accessed at 10.6084/m9.figshare.31959801

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Figures

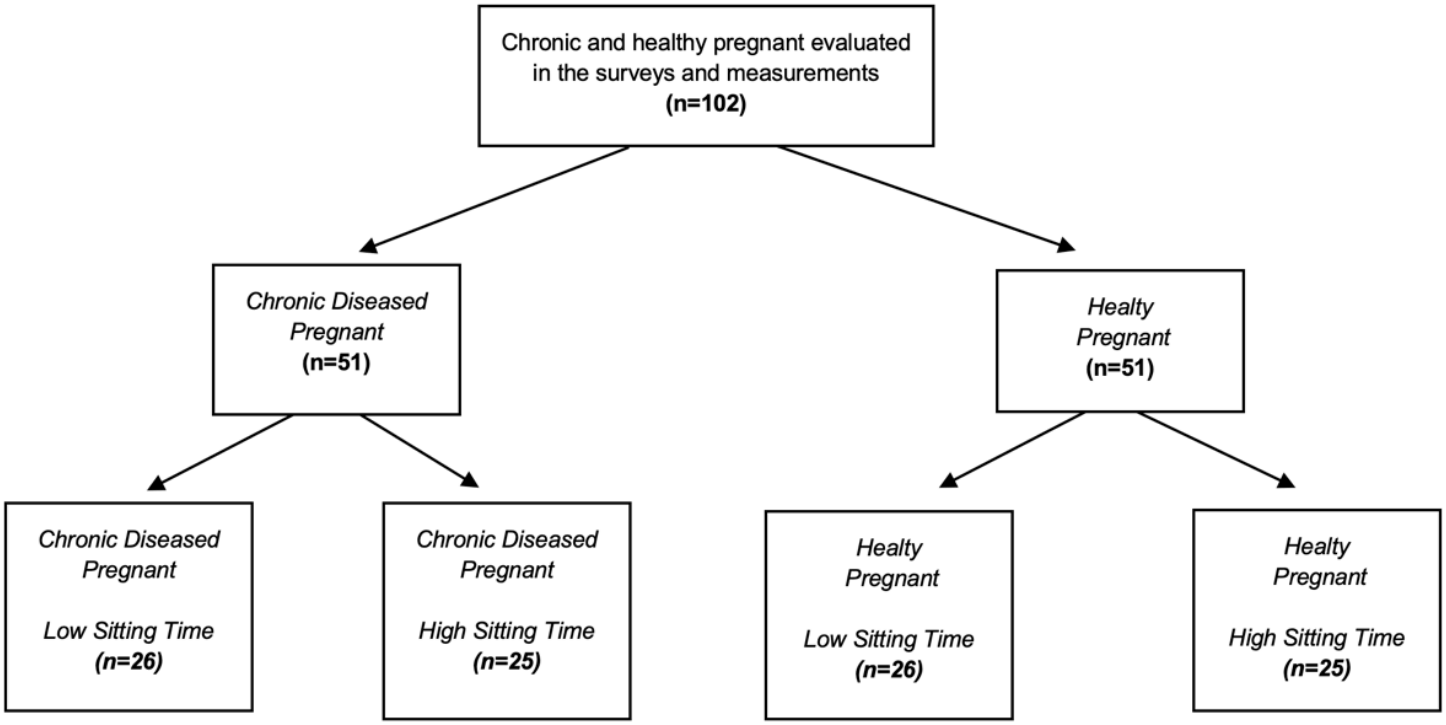


Figure 1

Participant Flow Diagram