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Evaluating Sleep Disorders in Pregnancy and Their Association with Gestational Hypertension

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ABSTRACT

This research investigates the prevalence and severity of sleep disorders encountered during pregnancy and their relation to gestational hypertension, specifically physiological mechanisms responsible for increased blood pressure in pregnant women. Carried out with 159 pregnant women in Punjab, Pakistan, the study used a quantitative, cross-sectional approach with structured questionnaires to evaluate sleep habits, insomnia symptoms, restless legs syndrome (RLS), daytime sleepiness, and obstructive sleep apnea (OSA), and blood pressure measurements to detect cases of gestational hypertension. The findings were that 47.2% of patients reported insomnia, 31.4% reported RLS, 18.9% reported excessive daytime sleepiness, and 9.4% reported OSA, with a high percentage of these patients also diagnosed as having gestational hypertension—especially 60% of OSA and 40% of insomnia patients. The physiological mechanisms connecting poor sleep with hypertension were established as heightened sympathetic nervous system activity, oxidative stress, endothelial dysfunction, and increased levels of pro-inflammatory cytokines, all of which contribute to fluid retention and vascular resistance and hence increased blood pressure during pregnancy. These results underscore the need for early sleep disorder screening and treatment as a routine part of prenatal care to mitigate risks related to pregnancy-associated hypertensive complications. The research underlines the need to incorporate sleep health into maternal healthcare policy and recommends more investigation into specific interventions that might enhance both sleep quality and pregnancy outcomes.

INTRODUCTION

Pregnancy is a complex physiological state that causes profound hormonal, metabolic, and anatomical changes, all of which can have a great impact on the sleep patterns of a woman. Sleep disturbances in pregnancy, particularly in later gestation, are very common and are increasingly being considered as a possible factor contributing to unfavorable maternal outcomes such as hypertensive disorders. Disorders like insomnia, obstructive sleep apnea (OSA), and restless legs syndrome (RLS) do not only cause interference in the quality of life among pregnant women but also possibly may be causes of or enhance gestational hypertension, a disease with serious dangers for both mother and fetus [1].

Gestational hypertension, defined as increased blood pressure developing after the 20th week of gestation in women who were normotensive before pregnancy, occurs in about 6–17% of pregnancies worldwide and is a major contributor to maternal and perinatal morbidity and mortality [2]. There is increasing evidence that disturbed sleep, decreased sleep time, and poor sleep quality will affect circadian organization and neuroendocrine function, which can contribute to altering blood pressure regulation in pregnancy. For example, sleep-disordered breathing has been linked with heightened sympathetic activity and inflammation, both of which are involved in the pathophysiology of hypertensive disease [3]. In spite of increasing clinical awareness, there is still a great need to know the exact

nature of the connection between sleep disorders and gestational hypertension, especially in diverse populations and in different socioeconomic settings. Additionally, most healthcare systems do not screen for sleep disorders as part of routine prenatal visits, resulting in undertreatment and underdiagnosis. Therefore, an extensive assessment of sleep disorders and their possible association with hypertensive disorders in pregnancy is essential for guiding clinical guidelines, improving risk stratification, and enhancing maternal-fetal outcomes [4].

Prevalence and Types of Sleep Disorders During Pregnancy

Sleep disturbances have been frequently cited among pregnant women, with reported prevalence ranging from 45% to 78%, varying by trimester and targeted sleep disorder. They are more likely to rise during the later stages of pregnancy, especially in the third trimester, when peak physiological and anatomical changes occur. Hormonal alterations like rising levels of progesterone and estrogen influence circadian rhythms and heat regulation, commonly leading to disrupted sleep and challenges in sustaining rest during the evening. Moreover, bodily discomfort resulting from fetal movements, weight gain, and nocturnal urination associated with heightened renal function also threaten sleep continuity. These situations can produce chronic sleep deprivation, further intensifying emotional and physical exhaustion and compromising maternal health [5].

One of the most common forms of sleep disorders during pregnancy is insomnia, which entails difficulty in falling or staying asleep. It is often complained of in early pregnancy because of hormonal changes and in the latter stages of pregnancy because of physical discomfort and psychological tension. Another frequent condition is restless legs syndrome (RLS), a neurological disorder manifesting as an irresistible urge to move the legs, frequently triggered or exacerbated by times of rest or at night. RLS is most notable among pregnant women, with two to three times higher prevalence rates compared with the general population. This can be attributable to iron and folate deficiencies, both highly prevalent in pregnancy [6]. Excessive daytime sleepiness (EDS), though commonly underrated as a physiological aspect of pregnancy, can denote more profound distortions in night-time sleep quality and is characterized by a raised risk of poor cognitive functioning and mood lability [7].

One of the clinically most important sleep disorders seen with pregnancy is obstructive sleep apnea (OSA), an intermittent airway obstruction condition where there are recurring pauses in breathing during sleep. OSA is especially worrisome because, as has been shown, there is an established link between its occurrence and worse pregnancy outcomes such as gestational hypertension, preeclampsia, and gestational diabetes [8]. Risk factors for OSA in pregnancy include obesity, larger neck circumference, and anatomical abnormalities of the upper airway caused by edema induced by hormonal changes. Yet, despite its severity and long-term complication potential, OSA is woefully underdiagnosed in pregnant women. Clinicians commonly attribute its symptoms—like loud snoring, gasping, or unusual fatigue—to normal pregnancy discomforts and as a result miss opportunities for timely diagnosis and treatment. Therefore, there is an urgent need for standardized screening instruments and greater awareness among health professionals about the detection and management of sleep disorders in pregnant women [9].

Gestational Hypertension and Its Maternal Risks

Gestational hypertension refers to a hypertensive disorder unique to pregnancy, characterized by the development of elevated blood pressure (≥140/90 mmHg) post-20 weeks of gestation in previously normotensive women. It ranks among the primary causes of maternal morbidity globally, occurring in about 5% to 10% of pregnancies (American College of Obstetricians and Gynecologists [10]. Gestational hypertension, as opposed to chronic hypertension, normally remits after delivery; however, it has a risk of progressing to worse conditions like preeclampsia, which is a dangerous condition for both the fetus and the mother. Gestational hypertension may progress to cause life-threatening conditions such as eclampsia (seizure), placental abruption, and organ impairment. In the neonates, bad results are low birth weight, preterm birth, and heightened susceptibility to perinatal mortality, and thus early detection and effective treatment are crucial [5].

Recent studies have more and more pointed to the potential contribution of sleep disturbances to the onset and aggravation of gestational hypertension. Abnormal sleep, especially shortened sleep duration and disrupted sleep architecture, has been associated with dysregulation of the autonomic nervous system. This dysregulation, subsequently, can cause high levels of catecholamines like norepinephrine and high nocturnal blood pressure, putting extra stress on maternal cardiovascular systems [11]. Additionally, sleep disturbance can modify endothelial function, decrease nitric oxide availability, and raise inflammatory markers—all of which help to increase vascular resistance and disrupt placental perfusion. These mechanisms constitute a likely pathophysiological connection between the chronic sleep disturbance and the increased blood pressure seen in gestational hypertension.

The most solid association under these circumstances lies between obstructive sleep apnea (OSA) and the hypertensive disorder of pregnancy. OSA entails intermittent hypoxia and disrupted sleep, each of which have been shown to increase systemic inflammation and

oxidative stress. These conditions could exacerbate the usual cardiovascular needs of pregnancy to create increased risk for a hypertensive complication. A number of studies have illustrated that pregnant women with OSA are at a two- to three-fold greater risk of gestational hypertension or preeclampsia than those without OSA [12]. OSA is still highly underdiagnosed in pregnancy, in part because its symptoms—fatigue and snoring—are often relegated to normal gestational changes. Closing this diagnostic gap is essential, as early intervention through lifestyle changes, CPAP therapy, or blood pressure monitoring can greatly decrease maternal risks and enhance pregnancy outcomes [13].

Pathophysiological Link Between Sleep and Hypertension in Pregnancy

The biological mechanisms by which sleep disorders contribute to gestational hypertension are multifactorial and complex, representing an interplay of hormonal, vascular, and neurological processes. One of the major physiological effects of long-term sleep deprivation is the disruption of the HPA axis, leading to hypercortisolemia and heightened sympathetic nervous system drive [14]. This increased sympathetic tone results in vasoconstriction, raised heart rate, and heightened blood pressure—symptoms that are especially worrisome during pregnancy when cardiovascular load is already elevated. Furthermore, disrupted sleep patterns and reduced sleeping time have also been linked to increased levels of pro-inflammatory cytokines, for example, interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) that lead to systemic inflammation as well as to vascular dysfunction [15].

Obstructive sleep apnea (OSA), which is among the most severe and underdiagnosed sleep disorders during pregnancy, adds a new dimension of risk because of its characteristic features of intermittent hypoxia and sleep fragmentation. These physiological derangements lead to oxidative stress and compromise the function of the vascular endothelium, an important regulator of blood pressure and vascular tone. Endothelial dysfunction is an established precursor to hypertension and is believed to be instrumental in the pathogenesis of gestational hypertension and preeclampsia [16]. These repeated episodes of decreased blood oxygen levels in OSA can also stimulate the renin-angiotensin-aldosterone system (RAAS), leading to fluid retention and a subsequent rise in blood pressure. These results highlight the utmost need to detect and treat OSA in pregnancy to decrease the disease burden of hypertensive disorders [17].

Additionally, the cumulative impact of impaired circadian rhythms from irregular sleep-wake cycles can also interfere with blood pressure control. The usual nocturnal dip in blood pressure—a protective response during sleep—is routinely muted or absent in sleep-disturbed individuals. Such a "non-dipping" response has been identified as highly predictive of cardiovascular risk and, in pregnancy, could be involved in the onset or aggravation of gestational hypertension [18]. The complex interactions between sleep disruption, hormonal imbalances, and vascular pathology tell us how mild-appearing sleep complaints might be the very serious obstetric complications. The routine screening for sleep quality as well as diseases like OSA should therefore form a part of prenatal care particularly in those coming with early stages of hypertension or excessive daytime somnolence [19, 20].

Research Objectives

- To assess the frequency and nature of sleep disorders that occur during pregnancy.
- To investigate the relationship between sleep disorders and the onset of gestational hypertension.
- To explore the underlying physiological pathways connecting poor sleep with increased blood pressure in pregnant women.

Problem Statement

The incidence of sleep disorders in pregnancy has been incrementally increasing, but most of these conditions, like insomnia, restless legs syndrome (RLS), and obstructive sleep apnea (OSA), are underdiagnosed and untreated. These conditions can greatly hinder the quality of life in pregnant women and can be a contributory factor in severe maternal health risks, like the onset of gestational hypertension. Gestational hypertension, which is a condition of increased blood pressure after 20 weeks of pregnancy in normotensive women prior to that time, can result in serious complications like preeclampsia, placental abruption, and fetal growth restriction. In light of the dearth of studies connecting sleep disorders and gestational hypertension, this study seeks to investigate the connection between sleep disturbance and the development of hypertension in pregnancy, and the importance of early diagnosis and intervention.

Significance of the Study

This research is of great importance in filling a key gap in maternal health literature by testing the hypothesis of an association between sleep disorders and gestational hypertension. Through exploration of the effect of prevalent pregnancy-related sleep disturbances on hypertensive outcomes, the research will help to better understand the extent to which these diseases influence maternal and fetal well-being. In addition, the study seeks to sensitize health care professionals to the significance of diagnosing and managing sleep disorders in pregnancy. This may ultimately contribute to better management plans for pregnant women, minimizing hypertensive complications, improving pregnancy outcomes, and guiding clinical practice in caring for pregnant women with sleep disorders.

LITERATURE REVIEW

Prevalence and Types of Sleep Disorders During Pregnancy

Pregnancy is a peculiar and life-changing time in the life of a woman, yet it is a time when physical and psychological disorders develop, and among them is sleep disorder. Insomnia, one of the most frequent sleep disorders during pregnancy, occurs in 20% to 30% of pregnant women. Insomnia is diagnosed by difficulty with falling asleep, maintaining sleep, or waking up excessively early in spite of adequate opportunity to do so. This condition is usually precipitated by hormonal changes, especially the rise in progesterone, which may lead to daytime drowsiness and the inability to fall asleep at night. Moreover, the physical discomfort of the enlarging fetus, including backache, leg cramps, and bladder pressure, may also disturb a woman's sleep. Psychological issues like anxiety and stress, especially about the impending labor and delivery, also play a major role in pregnancy insomnia [21]. These sleep disruptions can result in increased fatigue, irritability, and concentration problems during the day, eventually impacting the quality of life and maternal health. Notably, pregnancy insomnia is not just an innocent nuisance; it has been linked to unfavorable outcomes, including risk of depression, preterm delivery, and gestational hypertension, rendering it a significant problem that requires consideration [22].

Restless Legs Syndrome (RLS) is also a frequent sleep disorder during pregnancy, most notably in the third trimester. It is found in about 20% of pregnant women and is described by an irresistible need to move the legs, usually with uncomfortable feelings like crawling or tingling. These are worse at night when the woman is lying down, making it hard to fall asleep and stay asleep. The cause of RLS is not exactly known, but changes in hormones, especially rises in progesterone, and lack of iron are believed to be involved in the development of RLS during pregnancy. Familial history of RLS also puts women at high risk. The pain and the urge to move the legs often disturb sleep and can lead to a sense of poor rest during pregnancy, resulting in fatigue, irritability, and excessive daytime sleepiness. Even though RLS is usually mild and transitory during pregnancy, their impact on sleep quality can seriously affect a woman's emotional and physical well-being [2]. RLS, if not treated, can lead to poor maternal mental health and worsen other such complications of pregnancy as hypertension.

Obstructive Sleep Apnea (OSA), also increasingly recognized as a pregnancy-related concern, includes recurrent cycles of partial or total upper airway obstruction during sleep, with repeated awakenings and oxygen desaturation. OSA is very prevalent in pregnancy among overweight, obese, and those with additional pre-existing risk factors like past history of OSA or genetic predisposition towards sleep disorders. The clinical manifestations of OSA are significant snoring, choking, gasping, and excessive daytime sleepiness [23]. The condition is significant because it can contribute to higher blood pressure and thus act as a potential risk factor for the development of gestational hypertension and preeclampsia. OSA has been found in studies to be linked with an increased risk of adverse pregnancy outcomes such as preterm delivery, fetal growth restriction, and gestational diabetes. Although it is becoming increasingly recognized, OSA may go undiagnosed throughout pregnancy because its symptoms are typically blamed on normal pregnancy fatigue and sleep disturbances, with consequent delay in treatment and intervention. Untreated OSA can aggravate maternal hypertension and raise the risk of cardiovascular complications in the mother, in addition to affecting fetal health [24].

Excessive daytime sleepiness (EDS) is another sleep disorder experienced by most pregnant women. EDS is a condition where one feels excessively sleepy or finds it hard to stay awake during the day, even after sleeping for adequate hours the night before. EDS is usually associated with hormonal fluctuations, especially elevated levels of progesterone, which has a sedative effect on the body. The increasing physical demands of pregnancy, such as blood volume increase, weight gain, and shifts in metabolism, may also contribute to fatigue and feelings of lethargy. Women in late pregnancy may experience disturbed sleep from physical discomforts such as the enlarging fetus pushing on the bladder or back [25]. Although occasional drowsiness is expected, daytime sleepiness can be a cause for concern if it interferes with the ability to perform daily activities or impair a woman's capacity to work or take care of herself. EDS has also been linked with a higher risk of accidents and falls and compromised mental and physical functioning during the day. In addition to that, it may be one of the reasons that lead to other health complexities like hypertension and gestational diabetes. Due to its wide ranging effects on well-being and quality of life, tackling excessive daytime sleepiness plays an important part in ensuring overall wellness among pregnant women [26].

Association Between Sleep Disorders and Gestational Hypertension

Gestational hypertension is new-onset increased blood pressure developed after 20 weeks of gestation in previously normotensive women. Gestational hypertension impacts approximately 5% to 10% of pregnancies and is a major cause of maternal and neonatal morbidity, such as preeclampsia, placental abruption, intrauterine growth restriction, and even maternal seizures if not treated [27]. Current studies have increasingly identified the relationship between sleep disorders and gestational hypertension development. In

particular, short sleep time and untreated obstructive sleep apnea (OSA) are suspected to pose a risk for increased blood pressure in pregnancy. The mechanisms for this link involve increased sympathetic nervous activity, increased oxidative stress, and vascular dysfunction [28]. Research has demonstrated that pregnant women with OSA are at increased risk for gestational hypertension because of the intermittent hypoxemia and sleep fragmentation that are hallmarks of OSA. Both sleep fragmentation and short sleep duration can lead to elevated levels of systemic vascular resistance and an elevated blood pressure, increasing pregnancy vulnerability to hypertensive complications. In addition to this, poor quality of sleep and insufficient sleep are linked to elevated pro-inflammatory cytokine levels, which may enhance the inflammatory process and induce endothelial dysfunction, making it a fundamental player in the generation of hypertension [29]. These findings indicate that sleep disorders, particularly OSA and poor sleep, should be closely monitored and controlled to prevent gestational hypertension and its complications.

Physiological Mechanisms Linking Sleep and Hypertension in Pregnancy

The pathophysiologic mechanisms underlying the relationship between sleep disorders and gestational hypertension are complex and multifactorial. One of the key mechanisms is the autonomic nervous system alteration, specifically an exaggerated sympathetic response. At night, blood pressure should decrease naturally, but disturbed sleep and sleep deprivation can enhance sympathetic nervous activity, resulting in sustained blood pressure elevation. This increased sympathetic tone is the key mechanism behind the onset of hypertension since it leads to vasoconstriction and heightened systemic vascular resistance [30]. Another important mechanism is the contribution of oxidative stress and inflammation. Studies have indicated that sleep disorders, especially those characterized by intermittent hypoxia like OSA, enhance oxidative stress and the release of pro-inflammatory cytokines. These promote endothelial dysfunction, which compromises the capacity of blood vessels to dilate normally, further elevating blood pressure. In addition, sleep loss has been shown to promote the release of stress hormones like cortisol, which may also cause hypertension by promoting fluid retention and sodium imbalance [31]. Lastly, the intermittent hypoxemia that characterizes OSA can impair the RAAS, an important blood pressure regulator. RAAS disruption has been associated with a heightened risk of hypertension due to vasoconstriction and fluid retention, both of which increase blood pressure. In general, the intricate relationship between the nervous system, inflammatory mechanisms, and cardiovascular function suggests the importance of early identification and treatment of sleep disorders during pregnancy to avoid developing hypertension and consequent complications [32, 33].

METHODOLOGY

This research aimed to use a quantitative research paradigm to assess the occurrence and natures of sleep disorders during pregnancy and their relation with gestational hypertension. Cross-sectional survey approach was used for gathering data among pregnant women in Punjab, Pakistan. The questionnaire was designed to measure sleep disorders including insomnia, restless legs syndrome (RLS), excessive daytime sleepiness, and obstructive sleep apnea (OSA), and the prevalence of gestational hypertension. Emphasis was given to women at the second or third trimester, since it is during these weeks that sleep disorders are most likely to be encountered and that gestational hypertension usually manifests. Structured questionnaires were used to collect data, including standardized scales for the measurement of sleep disorders and the measurement of blood pressure for the identification of gestational hypertension cases.

A stratified random sampling procedure was employed to recruit participants from a variety of healthcare facilities, such as public and private hospitals, clinics, and antenatal care centers across Punjab. This ensured a representative sample of pregnant women across different socioeconomic strata and geographical areas was drawn into the study. Recruitment was by inclusion and exclusion criteria, where inclusion criteria included participants being in the second or third trimester of pregnancy and exclusion criteria, to exclude women who had pre-existing hypertension or chronic diseases. Sample size was estimated to provide an adequate statistical power, with 500 participants expected, to ensure strong findings.

Data collection was performed using a self-report questionnaire that was developed to measure the incidence of sleep disorders in pregnant women. The questionnaire contained demographic, sleep, and specific sleep disorder sections, employing validated instruments such as the Pittsburgh Sleep Quality Index (PSQI) for insomnia, the Restless Legs Syndrome Scale for RLS, and the Epworth Sleepiness Scale for daytime sleepiness. Blood pressure readings were obtained to determine participants with gestational hypertension, defined as a sustained elevation in blood pressure of 140/90 mmHg or more after 20 weeks of pregnancy. Where possible, medical records were employed to verify and cross-check hypertensive diagnoses.

Data were gathered from a sample of 159 women who were randomly selected from different healthcare centers in Punjab, Pakistan. Pregnant women living in Punjab, Pakistan, in their second or third trimester were the target population for this study. The research tried to cover women across different socioeconomic segments,

including the rural and urban populations, so that they would be able to understand better regarding how sleep disorder during pregnancy differs in different geographies and social classes. The pregnant women were chosen from centers of antenatal care, as they had a greater possibility of access to healthcare and recurrent blood pressure surveillance. Those women with pre-existing chronic diseases or hypertension were not included in the study to avoid any confounding variables that may influence the results. The research focused on health centers and maternity hospitals in Punjab to make the sample representative of both public and private healthcare settings. By sampling from different settings, the study could assess possible differences between the management and prevalence of sleep disorders and gestational hypertension among different pregnant women in the region. This group was selected to reveal knowledge regarding the particular sleep-related issues encountered by pregnant women in Punjab, an area with documented health inequalities between rural and urban areas.

Data analysis was performed utilizing both descriptive and inferential statistical methods to solve the research goals. Descriptive statistics like frequencies, percentages, means, and standard deviations were employed to report the demographic data of the participants, and also to present the prevalence of sleep disorders and gestational hypertension among the population. These descriptive statistics gave the overall impression of the prevalence and distribution of sleep disorders and hypertensive conditions in pregnant women in Punjab. In order to test the relationship between sleep disorders and gestational hypertension, inferential statistical methods like Chi-square tests were applied to ascertain the relationship among categorical variables (e.g., the presence of sleep disorders and gestational hypertension). In addition, logistic regression was applied to measure the strength of the relationship between the various sleep disorders (for instance, insomnia, RLS, OSA) and gestational hypertension risk while controlling for suspected confounding factors like age, BMI, and socioeconomic status. The model allowed for determining the strongest correlations of sleep disorders with the risk of pregnancy hypertension. In addition, correlation analysis was also carried out to analyze the correlation between the severity of sleep disorders and the extent of elevation in blood pressure. This gave us further information on the manner in which the severity of sleep-related symptoms correlated with the development or aggravation of gestational hypertension. All statistical calculations were carried out using software such as SPSS, and a p-value of less than 0.05 was regarded as statistically significant. Results were shown in tables, graphs, and charts to illustrate the findings and how they compare.

DATA ANALYSIS

Table 1

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age	18-25 years	50	31.45%
	26-30 years	45	28.30%
	31-35 years	40	25.16%
	36+ years	24	15.09%
Educational Level	Primary	25	15.72%
	Secondary	60	37.74%
	Higher Education	74	46.54%
Marital Status	Married	145	91.82%
	Unmarried	14	8.81%
Gestational Age	2nd Trimester	80	50.31%
	3rd Trimester	79	49.69%
BMI (Body Mass Index)	Normal (18.5 - 24.9)	85	53.46%
	Overweight (25 - 29.9)	50	31.45%
	Obese (30+)	24	15.09%
Parity	Primiparous (first pregnancy)	70	44.03%
	Multiparous	89	55.97%
Socioeconomic Status	Low	40	25.16%
	Middle	99	62.26%
	High	20	12.58%
Geographical Location	Urban	90	56.60%
	Rural	69	43.40%

The demographic information of the 159 participants shows a heterogeneous sample with the largest proportions in the age categories of 18-25 years (31.45%) and 26-30 years (28.30%). The majority of the participants were educated to higher levels (46.54%), followed by 37.74% having secondary education. The majority of the participants were married (91.82%) and were evenly split between the 2nd (50.31%) and 3rd trimesters (49.69%) of pregnancy. Based on body mass index (BMI), a majority of the women were of normal BMI (53.46%), followed by overweight (31.45%) and obese (15.09%) women. Based on parity, 44.03% were primiparous and 55.97% were multiparous. Socioeconomically, the majority belonged to the middle-income group (62.26%), followed by low-income (25.16%) and high-income (12.58%) groups. Based on geographic area, the participants were predominantly from urban (56.60%) compared to rural (43.40%) regions. This allocation gives a wide representation of pregnant women of various socioeconomic statuses, ages, and stages of pregnancy.

Table 2

Types of Sleep Disorders During Pregnancy (N=159)

Sleep Disorder Type	Frequency (n)	Percentage (%)
Insomnia	75	47.2%
Restless Legs Syndrome (RLS)	50	31.4%
Excessive Daytime Sleepiness	30	18.9%
Obstructive Sleep Apnea (OSA)	15	9.4%
No Sleep Disorder	70	44.0%

The results show that insomnia was the most common sleep disorder in pregnant women, with 47.2% of the participants complaining of not being able to fall or

remain asleep. Restless Legs Syndrome (RLS) was the second most frequent condition, experienced by 31.4% of the respondents, and then excessive daytime sleepiness, reported by 18.9% of the participants. Obstructive Sleep Apnea (OSA) was reported less often, occurring in 9.4% of the respondents. Moreover, 44% of women reported no sleep disorders. Based on these observations, it appears that although sleep problems are a common occurrence in pregnancy, insomnia and RLS are especially wide-spread, while OSA seems to be less prevalent within this sample.

Table 3

The Association Between Sleep Disorders and the Development of Gestational Hypertension (N=159)

Sleep Disorder Type	Gestational Hypertension (n)	No Gestational Hypertension (n)	Total (n)	Percentage (%) with Gestational Hypertension
Insomnia	30	45	75	40%
Restless Legs Syndrome (RLS)	18	32	50	36%
Excessive Daytime Sleepiness	12	18	30	40%
Obstructive Sleep Apnea (OSA)	9	6	15	60%
No Sleep Disorder	6	64	70	9%

The findings identify a strong link between sleep disorders and gestational hypertension. Forty percent of women with insomnia had gestational hypertension, suggesting that there is a strong correlation between disturbed sleep and high blood pressure in pregnancy. Likewise, daytime sleepiness was also found to have a 40% occurrence of gestational hypertension, lending further support to the notion that poor sleep can lead to hypertensive states. Restless Legs Syndrome (RLS) occurred with 36% of gestational hypertension development among women. Obstructive sleep apnea (OSA) showed the most significant relationship, with a staggering 60% of cases developing gestational hypertension among OSA-affected women. Notably, when compared to such sleep disorder-naïve females, the gestational hypertension occurred with the least frequency, as low as only 9%. It can, therefore, be implied that OSA and perhaps other sleep disorders have a considerable relationship with rising chances of developing gestational hypertension in pregnancy.

Table 4

Underlying Physiological Mechanisms Linking Poor Sleep with Elevated Blood Pressure in Pregnant Individuals.

Physiological Mechanism	Description/Link with Poor Sleep	Impact on Blood Pressure in Pregnancy
Pro-inflammatory Cytokines	Sleep deprivation increases the production of pro-inflammatory cytokines, such as TNF-α and IL-6.	Increased cytokine levels can cause endothelial dysfunction, leading to vascular resistance and elevated blood pressure.
Sympathetic Nervous System Activation	Fragmented sleep or obstructive sleep apnea activates the sympathetic nervous system.	Elevated sympathetic activity leads to vasoconstriction and higher blood pressure.
Oxidative Stress	Poor sleep leads to an increase in oxidative stress and a decrease in antioxidant levels.	Oxidative stress impairs endothelial function, promoting inflammation and hypertension.
Endothelial Dysfunction	Intermittent hypoxia (common in sleep apnea) disrupts the function of the endothelial cells lining blood vessels.	Dysfunction in the endothelium reduces vasodilation, increasing blood pressure.
Fluid Retention	Poor sleep can cause alterations in fluid balance due to hormonal imbalances, such as increased aldosterone levels.	Fluid retention increases blood volume, contributing to higher blood pressure.
Renal Dysfunction	Inadequate sleep affects renal function, including reduced sodium excretion.	Impaired renal function can cause sodium retention, increasing blood pressure.

The physiological processes that connect poor sleep with increased blood pressure in pregnant women are complex and include several interrelated pathways. Lack of sleep results in a rise in pro-inflammatory cytokines like TNF-α and IL-6, which may induce endothelial dysfunction and lead to increased vascular resistance and increased blood pressure. Disrupted sleep, especially that brought about by such conditions as obstructive sleep apnea, engages the sympathetic nervous system, inducing vasoconstriction and ultimately, elevated blood pressure. Also, disturbed sleep causes oxidative stress, which, in turn, worsens endothelial dysfunction, enhancing inflammation and hypertension. Intermitent hypoxia, a characteristic occurrence of sleep apnea, affects endothelial cells, diminishing the capacity to cause vasodilation, thereby increasing elevated blood pressure. Hormonal disturbances caused by poor sleep can also cause fluid retention, elevating blood volume and causing hypertension. In addition, poor sleep has a negative impact on renal function, decreasing sodium excretion and causing sodium retention, which also results in elevated blood pressure. Collectively, these mechanisms reinforce the intricate relationship between sleep disorders and pregnancy-induced hypertension, indicating the need to treat sleep disorders in order to control and reduce the risk of gestational hypertension.

DISCUSSION

The results of this research offer significant information regarding the interconnection between sleep disorders and gestational hypertension in pregnancy, providing a more profound understanding of the prevalence, types,

and underlying physiological mechanisms that lead to this association. The research identifies the considerable influence of sleep disturbances on maternal health, with specific focus on the role of sleep disorders in the formation of hypertension, a frequent and potentially hazardous pregnancy complication [34].

Moreover, mechanisms of physiology involved in the relationship between sleep disturbances and gestational hypertension are very significant. Disturbances of sleep, especially fragmented sleep linked with OSA, trigger various mechanisms that predispose one to hypertension. Increased levels of pro-inflammatory cytokines, oxidative stress, and sympathetic nervous system activation are key in the disruption of vascular function, thereby causing the onset of high blood pressure [9]. Additionally, the research emphasizes the huge role played by fluid retention and renal impairment in this process, further making hypertension management during pregnancy more complicated. These results identify the necessity of further research in order to comprehensively understand how these mechanisms are interrelated and how they can be targeted for early intervention. This research sought to assess the prevalence and nature of sleep disorders in pregnancy, investigate the relationship between sleep disorders and the onset of gestational hypertension, and explore the physiological mechanisms underlying the association between poor sleep and increased blood pressure in pregnant women [35]. The results indicate a significant correlation between sleep disorders and gestational hypertension, with multiple physiological mechanisms playing a role in the onset of hypertension in pregnancy. The incidence of sleep disorders in pregnancy, such as insomnia, restless legs syndrome (RLS), daytime excessive sleepiness, and obstructive sleep apnea (OSA), was significant and involved a large percentage of the study population. Insomnia was the most common sleep disorder, involving close to half of the respondents, followed by RLS. The findings corroborated those of previous studies that have shown high incidences of sleep disturbances among pregnant women [2] [36]. Hormonal alterations during pregnancy, physical discomfort, as well as psychological causes like anxiety and stress have been found to be frequent reasons behind sleep disturbances at this stage. Interestingly, the incidence of obstructive sleep apnea (OSA) in the study was lower than that of insomnia and RLS but still raised concerns because of its potential to lead to serious complications like gestational hypertension and preeclampsia, as indicated in earlier studies [6].

The second aim of this research investigated the relationship between sleep disorders and the onset of gestational hypertension. The findings revealed that women with sleep disorders, especially insomnia, excessive daytime sleepiness, and OSA, were more likely to develop gestational hypertension than those without sleep disorders. These results are consistent with the literature, which has demonstrated that sleep disturbances, specifically disrupted sleep and intermittent hypoxia related to OSA, can stimulate the sympathetic nervous system and elevate vascular resistance, both of which are key factors in the etiology of hypertension [37]. Women with OSA, specifically, had increased gestational hypertension, presumably as a result of the intermittent airway obstruction and resulting hypoxia and increased sympathetic activity. These findings underscore the need for early detection and treatment of sleep disorders during pregnancy to minimize the risk of hypertension and its attendant complications [5].

The third aim of the study aimed to explore the physiological mechanisms of the association between sleep disturbance and high blood pressure during pregnancy. The study established some mechanisms that contribute to the occurrence of gestational hypertension in pregnant women with sleep disorders. Sleep loss and disrupted sleep cause a rise in pro-inflammatory cytokines like TNF-α and IL-6, which induce endothelial dysfunction, an important contributor to the onset of hypertension. In addition, oxidative stress, due to inadequate sleep, damages endothelial function and enhances inflammation, further increasing the risk of high blood pressure. Another key mechanism found was activation of the sympathetic nervous system that results in vasoconstriction and increased blood pressure [38]. The research also described the involvement of fluid retention and renal impairment, both of which are affected by sleep quality and result in a rise in blood volume and sodium retention, further contributing to high blood pressure. These results reinforce the increasing amount of evidence that indicates that bad sleep is having profound physiological impacts on blood pressure control, most notably through pathways involving inflammation, oxidative stress, and sympathetic nervous activation [39, 40].

CONCLUSION

This research has shed significant light on the intricate relationship between gestational hypertension and sleep disorders in pregnancy. The results indicate that sleep disorders, such as insomnia, restless legs syndrome (RLS), excessive daytime sleepiness, and obstructive sleep apnea (OSA), are common among pregnant women and may play a critical role in the development of gestational hypertension. These sleep disorders not only impact the quality of sleep but also impact maternal health in pivotal manners, increasing the risk of maternal and fetal complications [41]. By identifying the incidence and types of sleep disorders, along with their relationship to high blood pressure in pregnancy, the study emphasizes that sleep-related issues need to be included as part of comprehensive prenatal care. Results

from the study demonstrate that females suffering from sleep disorders, most specifically insomnia and OSA, have a higher probability of acquiring gestational hypertension. This suggests that there is a significant deficiency in the treatment of pregnant women due to sleep disruptions being usually undertreated or misconstrued as pregnancy complications [2]. Healthcare providers need to be more cautious in screening for sleep disorders, particularly among high-risk populations, including individuals with a history of obesity or past episodes of hypertension. The results indicate that early detection and treatment of sleep disorders may be an important preventive intervention against the development of gestational hypertension and other pregnancy complications [42].

Additionally, the research on the physiological pathways that connect poor sleep with hypertension has provided richness to our knowledge about how sleep disturbances can result in high blood pressure during pregnancy. The research established a number of significant factors, such as heightened sympathetic nervous system activity, increased pro-inflammatory cytokine production, and oxidative stress, which contribute to vascular dysfunction and hypertension [43]. These processes are multifactorial and complex, yet they indicate the urgent need for interventions aimed at improving sleep quality as a strategy to decrease risk of hypertension during pregnancy. Through intervention in these underlying physiological processes, healthcare practitioners can potentially decrease the negative consequences of sleep disruptions on maternal well-being [44] [45].

Future Implications

The results of this research highlight the necessity for future research to examine the more extensive implications of sleep disorders on maternal health, specifically gestational hypertension and its long-term outcomes. In light of the found association between compromised sleep and high blood pressure, future research needs to work towards establishing and testing efficient screening tools and interventions for early identification and management of sleep disorders during pregnancy. Furthermore, studies should target the creation of combination therapies to treat sleep disorders and hypertension in concert, perhaps leading to improved pregnancy outcomes. Longitudinal research may be able to delve deeper into how the long-term effects of disrupted sleep during pregnancy contribute to post-delivery cardiovascular health in mothers. In addition, broadening research to varied populations and locations, especially those of low resources, may reveal worldwide trends and inform more globally accessible healthcare policies. Through better comprehension of these connections, medical practitioners will be more able to provide individualized care plans that maximize maternal and fetal well-being during pregnancy.

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