

Article

# Anxiety, Depression, and Salivary Cortisol Levels in Pregnant Women: A Comprehensive Review

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**Abstract:** Pregnancy is an extraordinarily dynamic period of growth and development, which poses significant physical and psychological challenges to pregnant women and their partners. Stress, anxiety, and/or depression are emotional states that reign today, and their effective management is becoming increasingly necessary due to the public health problems they pose. This study assessed and analyzed outcomes associated with anxiety, depression, and salivary cortisol levels in pregnant women. 88 samples of pregnant women whose ages ranged between 25-40 years were recruited. Mood symptoms were measured, which included anxiety, trait anxiety, and depression. This study identified that cortisol levels were classified as low ( $\leq 17.66 \mu\text{g/L}$ ) and high ( $>17.66 \mu\text{g/L}$ ). Measurements of salivary cortisol levels in pregnant women were also performed, which included Ehlers-Danlos syndrome, PHQ-2, and TPDS. Demographic rates showed that pregnant women aged 30-35 years had the highest percentage, which included 50%, the percentage of smokers was 20.45%, and the percentage of non-smokers was 79.55%. Comorbidities included high blood pressure in 20 women, and HIV in 5 Pregnant women, diabetes in 15 pregnant women, kidney disease in 6 pregnant women, rate of pregnant women with cortisol levels where low cortisol ( $\leq 17.66 \mu\text{g/L}$ ) included 22 pregnant women and high cortisol ( $> 17.66 \mu\text{g/L}$ ) included 66 pregnant women. The Ehlers-Danlos Syndrome score was  $10.24 \pm 3.78$ , the PHQ-2 was  $9.81 \pm 6.47$ , the TPDS was  $18.23 \pm 6.89$ , the mood for anxiety was  $36.71 \pm 8.53$ , trait anxiety was  $40.66 \pm 7.84$ , depression was  $20.43 \pm 9.22$ , and perceived stress was  $27.68. \pm 4.83$ . Our current study indicates that anxiety, depression, and salivary cortisol levels have a negative impact on the quality of life and mental and physical health of pregnant women.

**Citation:** Jawid, J. S., Mehdi, K. S., Hussein, S. A. A., & Al-Rubayee, T. J. K. Anxiety, Depression, and Salivary Cortisol Levels in Pregnant Women: A Comprehensive Review. World of Science: Journal of Modern Research Technologies 2024, 3(2), 58-67.

Received: 7<sup>th</sup> March 2024

Revised: 14<sup>th</sup> March 2024

Accepted: 21<sup>st</sup> March 2024

Published: 28<sup>th</sup> March 2024

**Keywords:** anxiety, depression, salivary cortisol levels, pregnant women, complications, quality of life



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## 1. Introduction

During pregnancy, as well as the postpartum period, women experience substantial mental along with physical changes [1]. Although many women see these changes as mostly beneficial, for others, they might provide a susceptibility to mental health problems

[2]. Depression is the most widely researched mental health issue during the perinatal period, which refers to the time from the start of pregnancy to the conclusion of the baby's first year of life [3]. Prevalence data indicates that roughly 20 percent of women have depression all over pregnancy, and a comparable percentage experience it in the first trimester following giving birth [2], [4].

The estimated incidence rates of depression during the first, second, as well as third trimesters are 7.4%, 12.8%, as well as 12.0% consequently [3], [5], [6]. The prevalence rate for diagnosing any anxiety condition during pregnancy is predicted to be 15.2% [7]. The impact of depression and anxiety upon the well-being in mothers is significant and has substantial economic consequences [8]. An investigation done through the London School in Economics has shown which perinatal mental anxiety issues result in a total cost of £8 billion for each birth cohort in the UK over a one-year period. The majority of these costs may be attributed to the adverse impacts experienced throughout fetal development as well as newborn life [9]. In Spain, the annual cost of mental disorders and neurological diseases is 84,000 million euros. Among these, mental disorders account for a higher expenditure of 46,000 million euros, while neurological diseases account for 38,000 million euros [8], [10], [11]. Although specific costs related to perinatal mental problems have not been found, it is important to note the significant financial burden caused by these conditions. Anxiety and depression, which are the most common mental illnesses, have a greater economic burden compared to physical conditions such as multiple sclerosis, epilepsy, nor brain tumors [12].

10%–20% of kids and teenagers worldwide are affected by mental health disorders, which are a significant source of long-term impairment. Unfortunately, the mental health requirements of children and adolescents are often disregarded, particularly in low- and middle-income nations. The uterine environment is a significant contributing factor to mental health issues [13]. There is sufficient scientific data to confirm that the emotional condition of parents might heighten the likelihood of emotional problems in their kids. Prospective longitudinal research indicates that these effects may continue through adolescence for early adulthood as well as that they are significant enough to have clinical and public health importance [14-17].

There is a growing body of research that emphasizes the significance in the uterine environment to many outcomes relating to the health of the fetus, newborn, child, and adult [18]. The intrauterine period, known for its fast growth and development, is a critical time during which any kind of influence may have harmful consequences on the developing systems and structures, ultimately affecting the neurobehavioral development in the offspring [19]. The development of the prenatal brain occurs at a remarkable pace. Neurogenesis may take place at a rate of 100,000 cells per minute. Both neurogenesis and cell migration are mostly finished by mid-gestation. During the 20th week of pregnancy, the cortical plate starts developing axons and synapses. In the third trimester, over 40,000 synapses are produced per minute [20]. The development of the fetal brain is influenced by the physiologic signals it obtained from the mother, particularly those resulting from variations in her emotional state. The impact on the fetal brain is contingent upon both the stage of pregnancy and the specific brain system undergoing development [21].

Research strongly supports the Barker hypothesis, also known as fetal programming, which suggests that the conditions in the womb can impact the development of the fetus during specific sensitive periods [22]. This can have long-lasting or permanent effects on the physical characteristics of the individual, and consequently, many adult diseases can be traced back to disruptions in development and biology that occur in early childhood. These disruptions are specifically caused by the incorporation of adverse factors during critical stages of development. During embryonic development, the organs and tissues of the body undergo crucial times of growth, known as "critical" periods, which often occur during periods of high cell division [23], [24].

## 2. Materials and Methods

We conducted a cross-sectional study of pregnant women who suffer from anxiety, depression, and disturbances in cortisol levels. Eighty-eight pregnant women were collected; their ages ranged between 25 and 40 years. These collected and identified clinical data that included age, body mass index, smoking status, education level, employment level, and income level.

Our study recorded the clinical characteristics of pregnant women and infants. Characteristics of pregnant women included method of delivery (vaginal delivery and cesarean section), gestational age, prenatal care during follow-up, type of pregnancy (single and multiple), parity, and comorbidities, while characteristics of infants included infant sex and weight at birth in grams, small for gestational age, weight for length z-score (<10th percentile), and head circumference.

Furthermore, mood symptoms were measured, which included anxiety, trait anxiety, depression, and perceived stress, and pregnancy experiences (trouble frequency, trouble severity, lifting frequency, lifting intensity, and severity rate) in pregnant women through the use of self-report scales. Also, this study identified that cortisol levels were classified as both low ( $\leq 17.66 \mu\text{g/L}$ ) and high ( $> 17.66 \mu\text{g/L}$ ). Measurements of salivary cortisol levels were also performed in pregnant women, which included Ehlers-Danlos syndrome, PHQ-2, and TPDS.

This study evaluated, designed, and determined the methodology for data on pregnant women using SPSES version 22. This study defined the inclusion criteria, which included pregnant women between the ages of 25 and 40 and women who suffer from psychological and physical diseases, while the exclusion criteria included patients who suffer from other serious chronic diseases, women who are less than 25 years old, or teenage women.

## 3. Results

The results of this study is given on Table 1, 2, 3, 4, 5 and Figure 1, 2, 3.

**Table 1.** Clinical and demographic characteristics associated with pregnant women

Characteristics	Number of patients (88)	Percentage (%)
Age		
25 – 29	12	13.64%
30 – 35	44	50.0%
36 – 40	32	36.36%
BMI [kg/m <sup>2</sup> ]		
Normal (18.5–22.9)	36	40.91%
Underweight (<18.5)	6	6.82%
Overweight (23–24.9)	20	22.73%
Obese ( $\geq 25$ )	26	29.55%
Smoking		
Yes	18	20.45%
No	70	79.55%
ASA (%)		
I	10	11.36%

II	15	17.05%
III	53	60.23%
IV	10	11.36%
Education status		
Primary	9	10.23%
Secondary	14	15.91%
College / University	65	73.86%
Employment status		
Employed	65	73.86%
Unemployed	23	26.14%
Income status, \$		
< 900	55	62.5%
≥ 900	33	37.5%

**Table 2.** Characteristics of pregnant women

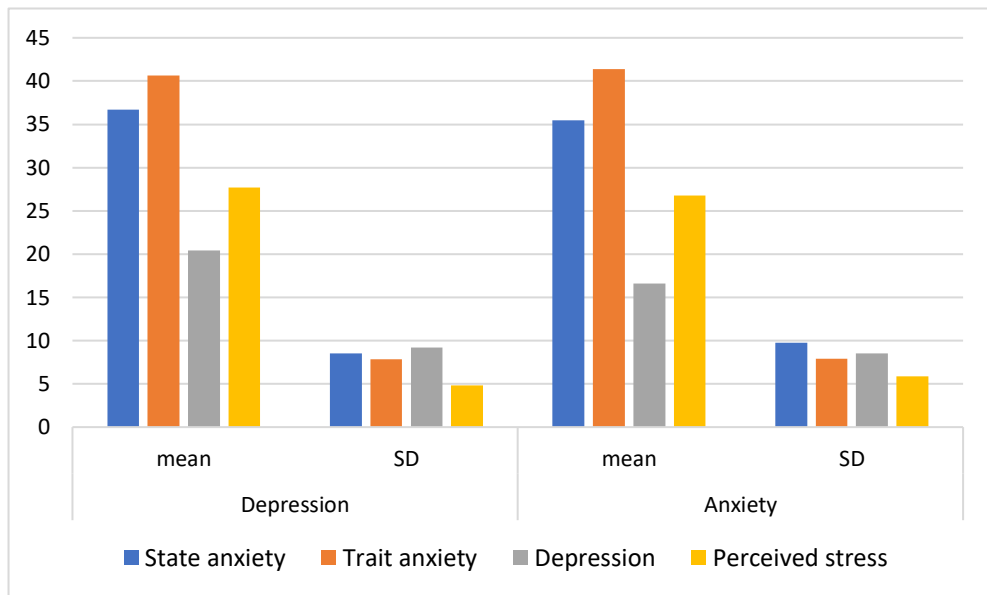
Variables	Number of patients (88)	Percentage (%)
Mode of delivery		
Vaginal delivery	62	70.45%
Cesarean section	26	29.55%
Gestational age, weeks		
< 36	53	60.23%
36 – 40	22	25.0%
> 40	13	14.77%
Antenatal care during follow-up		
Yes	64	72.73%
No	24	27.27%
Types of Pregnancy		
Single	60	68.18%
Multiple	28	31.82%
Parity		
Primiparous	37	42.05%
Multiparous	51	57.95%
Comorbidities		

Hypertension		
Yes	20	22.73%
No	68	77.27%
HIV		
Yes	5	5.68%
No	83	94.32%
Diabetes mellitus		
Yes	15	17.05%
No	73	82.95%
Kidney diseases		
Yes	6	6.82%
No	82	93.18%
Others		
Yes	11	12.5%
No	77	87.5%

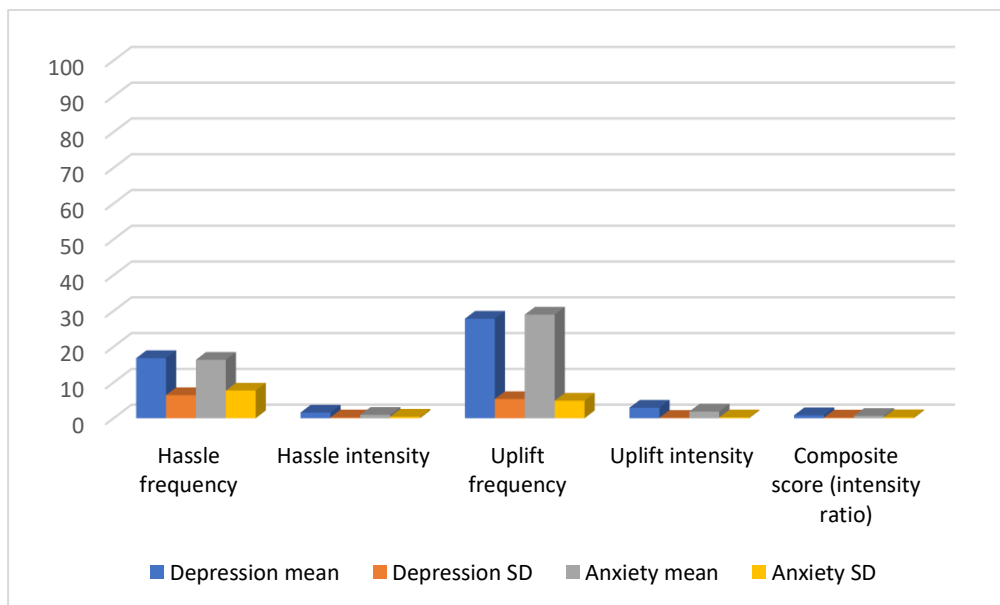
**Table 3.** Identify of infants' characteristics

Parameters	Number of patients (88)	Percentage (%)
Infant gender		
Male	54	61.36%
Female	34	38.64%
Birth weight in grams		
< 1500	18	20.45%
> 1500 – 3500	62	70.45%
> 3500	8	9.09%
Small for gestational age		
Yes	35	39.77%
No	53	60.23%
Weight for length z-score (<10 <sup>th</sup> percentile)		
No	68	77.27%
Yes	20	22.73%
Head circumference (<10 <sup>th</sup> percentile)		

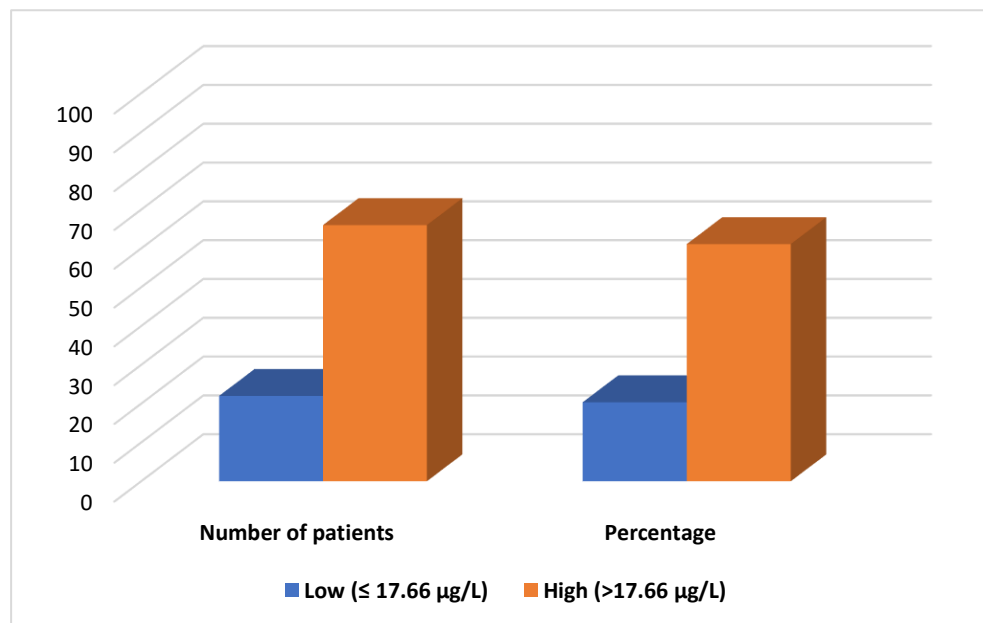
No	79	89.77%
Yes	9	10.23%
Sum of skinfold thickness (<10 <sup>th</sup> percentile)		
No	66	75.0%
Yes	22	25.0%



**Figure 1.** Measure mood symptoms of pregnant women by self-report scales



**Figure 2.** Measure pregnancy experiences at women by quality-of-life scale



**Figure 3.** Determining rate of pregnant women with cortisol levels

**Table 4.** Measurements of salivary cortisol levels at pregnant women

Scales	Cortisol level scores
Ehlers-Danlos Syndrome	10.24 $\pm$ 3.78
PHQ-2 scale	9.81 $\pm$ 6.47
TPDS scale	18.23 $\pm$ 6.89

**Table 5.** Assessment of quality of life for pregnant women in terms of physical and psychological aspects

Items	Scores
Physical function	56.34 $\pm$ 12.23
<b>Cortisol factor</b>	34.24 $\pm$ 3.67
Psychological function	
<b>Depression</b>	36.78 $\pm$ 7.89
<b>Anxiety</b>	32.19 $\pm$ 5.78
Social function	54.43 $\pm$ 2.46
Activity function	41.45 $\pm$ 6.43

#### 4. Discussion

Demographic rates showed that pregnant women aged between 30-35 years had the highest percentage, which included 50%, and BMI indicators, which included Normal (18.5-22.9) were 36 cases, Underweight ( $<18.5$ ) were 6 cases, Overweight (23-24.9) were 20 cases and Obese ( $\geq 25$ ) were 26 cases. The percentage of smokers was 20.45%, and the percentage of non-smokers was 79.55%.

This study determined the characteristics of pregnant women and infants, as the percentage of pregnant women who underwent vaginal delivery was 70.45% and for cesarean

section was 29.55%, the type of pregnancy included singleton was 68.18% of pregnant women and multiple was 31.82%, comorbidities included hypertension with 20 women and HIV was five pregnant women, diabetes was 15 pregnant women, kidney disease was six pregnant women, while infant characteristics included males 61.36% and females 38.64%, small for gestational age was 35 cases, and head circumference was 9 cases.

This study recorded data from psychological assessment questionnaires for pregnant patients, which determined the mood symptoms of anxiety were  $36.71 \pm 8.53$ , trait anxiety was  $40.66 \pm 7.84$ , depression was  $20.43 \pm 9.22$ , and perceived stress was  $27.68 \pm 4.83$ . The rate of pregnant women with cortisol levels was low ( $\leq 17.66 \mu\text{g/L}$ ) for 22 pregnant women and high ( $> 17.66 \mu\text{g/L}$ ) for 66 pregnant women. The Ehlers-Danlos Syndrome score was  $10.24 \pm 3.78$ , the PHQ-2 scale was  $9.81 \pm 6.47$ , and the TPDS scale was  $18.23 \pm 6.89$ .

The occurrence of anxiety and depression of pregnant women have been shown to significantly affect the health outcomes for the mother as well as the child, where elevated levels of anxiety and depression during pregnancy have been associated with worse birth outcomes, including preterm birth, low birth weight, and developmental deficits in infants [25], [26].

Another study has also shown a correlation between elevated levels of salivary cortisol, a hormone that's associated with stress, and increased levels of sadness and anxiety in pregnant women. Elevated cortisol levels may have adverse effects on fetal development and infant health [27].

Elevated levels of salivary cortisol, a hormone linked to stress, have been correlated with heightened levels of sadness and anxiety in pregnant women [28]. Persistent stress, inadequate social support, financial worries, and medical complications during pregnancy are the primary factors contributing to increased cortisol levels in pregnant women [29]. Moreover, maternal anxiety and depression may significantly harm the overall well-being of both the mother and child, possibly leading to long-lasting consequences regarding their physical, emotional, and social well-being [30].

## 5. Conclusion

The current study showed that there is a negative and dangerous effect of anxiety, depression, and salivary cortisol on the general health of pregnant women, resulting in a risk of premature birth and low birth weight, as well as causing delayed growth in infants. In addition, an increase in salivary cortisol levels generates negative consequences, such as causing complications during pregnancy, such as gestational diabetes and preeclampsia, which affect the quality of a healthy life in both physical and psychological aspects.

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