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Marital Age, Cigarette Exposure, Physical Activity, Sleep Duration, and Prenatal Depression

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ABSTRACT

Background: Extensive studies indicate that prenatal depression disrupts a woman's life and has a detrimental effect on the mother-child and further breastfeeding. Numerous factors associated with nutrition, physical activity, sleep patterns, and exposure to cigarette smoke are strongly suspected of contributing to the dysregulation of hormones associated with depression. This study aims to examine the association between physical activity, nutritional status, prior exposure to cigarette smoke, and the risk of prenatal depression. **Method**: A cross-sectional study was conducted on 79 pregnant women at the Pampang Primary Healthcare Center between January and March 2021. Using chi-square and multiple logistic regression, identify the risk factors that most significantly contribute to the risk of prenatal depression. **Result**: Married under the age of 19th ($p<0.039$), inactive daily exercise ($p<0.023$), inadequate sleep duration ($p<0.045$), and mothers who have been exposed to cigarette smoke for more than a year ($p<0.001$) all increased the risk of prenatal depression. Cigarette exposure, contributes most, with a 5.4-fold increased risk of developing mental disorders while breastfeeding. **Conclusion**: It is critical for health services to include early screening for prenatal depression during antenatal care as a means of preventing future breastfeeding difficulties, particularly in mothers with vulnerability.

1. Introduction

Postpartum depression manifests itself in new mothers as mild mental behavioral disorders, emotions, depression, feelings of sadness, worthlessness, and hopelessness, and typically lasts four to six weeks after delivery [1]. Mental health in developing countries requires attention due to its increasing prevalence. Pre-postnatal depression prevalence increased by 18.4 percent globally between 2005 and 2015 [2], and 19.8% reported in 17 low and middle-income countries [3]. In India, depression was found to be prevalent in 11% of 359 primiparous mothers [4,5], whereas in Africa, 16.84% of pregnant women with adverse obstetric conditions [6]. The meta-analysis revealed that the prevalence of depression in pregnant women increased by 4.6 percent between the first and second trimesters [7]. According to the 2018 National Health Survey, depression prevalence in Indonesia reached 6.1 percent in both urban and rural areas. Around 7.4 percent of females and 5.8 percent of women aged 10 to 54 years suffer from depression [8]. Postpartum depression affects between 50% and 70% of postpartum mothers in Indonesia. In 2009, research conducted in several hospitals in Indonesia, including the Haji Adam Malik General Hospital in Medan, found that 16% of postpartum mothers admitted to the hospital suffered from postpartum

depression [9]. Postpartum depression was also reported to be quite prevalent at Sadwa Mother and Child Hospital Yogyakarta in 2017, at 7.7 percent. This demonstrates that postpartum depression requires awareness, particularly in terms of risk factor prevention [10].

According to a 2019 study conducted in several Primary Health Care facilities throughout Makassar City, the prevalence of depression among women is increasing, and they are more vulnerable than men. More than half of the 225 postpartum mothers reported experiencing signs and symptoms of depression [11]. Postpartum depression significantly disrupts a woman's life and has a detrimental effect on the mother's relationship with her child and partner. Women who have experienced postpartum depression have a higher incidence of divorce, child abuse and neglect, chronic depression, suicide, and infanticide [12,13]. Numerous hypotheses explain depression by activating the HPA (Hypothalamus Pituitary Axis), which is triggered by increased cortisol secretion in response to environmental stress, which tends to increase during pregnancy [14–17]. Postpartum depression is caused by pathological abnormalities of the Hypothalamic-Pituitary-Adrenal (HPA) axis pathway [16]. At the time of conception, it is physiological and continues to increase characteristically, up to threefold in the third trimester, but this increase is also accompanied by an increase in Cortocotrophine Releasing Hormone-Binding Protein (CRH-BP) [18]. As CRH-BP levels decrease toward the end of pregnancy, cortisol begins to function for labor [19].

Postpartum depression has clinical symptoms similar to those of generalized depression throughout a woman's life, but these symptoms begin physiologically during pregnancy and childbirth [20]. Postpartum depression has clinical symptoms similar to those of generalized depression throughout a woman's life, but these symptoms begin physiologically during pregnancy and childbirth [20]. Numerous empirical studies have established a link between several risk factors and nutritional status [21], physical activity [21], sleep duration [22], and cigarette exposure [23].

The Pregnancy Risk Monitoring System Survey found that active smoking during pregnancy was associated with a 1.6-fold increased risk of postpartum depression, providing some evidence for moderate-exposure depressive symptoms in perinatal women [24]. Mothers who abstained from smoking during pregnancy had a reduced risk of developing depressive symptoms compared to those who were continuously exposed to smoking [23]. Numerous studies have established a causal relationship between maternal smoking during pregnancy and an increased risk of preterm birth, stillbirth, low birth weight infants, and placental separation [24]. Cigarette smoke has an anti-estrogenic effect, inhibiting the biosynthesis and bioavailability of endogenous estrogen, increasing the risk of postpartum depression [24]. Malnutrition also plays a role in the development of postpartum depression, specifical deficiency of n-3 polyunsaturated fatty acids (PUFAs), B vitamins, vitamin D, and minerals [25]. Observational studies indicate that a variety of nutritional components may be associated with depression. These include associations with nutrient deficiency, with vitamin D and omega-3 fatty acids being the most frequently studied [26]. Plasma riboflavin or vitamin B2 levels were significantly lower in the postpartum depression group (13.9%) than in the asymptomatic group [25].

Women who engaged in moderate physical activity had a lower risk of depression than women who engaged in more sedentary activities [27]. A randomized controlled trial of elderly women who engaged in three different levels of physical activity found that the more consistent the level of physical activity, the more protected against depression's effects [28]. Sleep duration is also consistently reduced in pregnant women, as a physiological consequence, and is prolonged postpartum to the breastfeeding period, according to numerous studies. However, nocturnal sleep quality is disturbed as a result of increased depressive symptoms [29–31]. As a result, it is necessary to determine which of the numerous risk factors possessed by pregnant women contributes the most to prenatal depression to prioritize preventive measures targeting modifiable risk factors, we focus this study on the prenatal period. In particular, this study will examine the association between physical activity, nutritional status, prior exposure to cigarette smoke, and the risk of prenatal depression.

2. Materials and Method

This cross-sectional study was conducted at Pampang Primary Health Care, Makassar, from May-July 2021. The study sample consisted of 75 pregnant mothers third trimester, without pregnancy complications. The subject was asked to sign the informed consent regards after hearing the study procedure. Selected through consecutive sampling, after the minimum requirement achieved, with a significance level of 5%, test power of 80%, and precision of 0.2 was calculated using a formula sample size (1) based on study design [32].

$$n1 = n2 = \left(\frac{Z_\alpha\sqrt{2PQ}+Z_\beta\sqrt{P_1Q_1+P_2Q_2}}{P_1-P_2}\right)^2 \quad (1)$$

$Z_\alpha = alfa\ 5\%\ (1.96)$

$Z_\beta = beta\ 20\%\ (0.84)$

$P_2 = Risk\ factors\ in\ pregnant\ woman\ without\ depression = 7\%\ or\ (0.7)$

$Q_2 = 1 - P_2 = 1 - 0.7 = 0.3$

$P_1 = PRisk\ factors\ in\ pregnant\ woman\ with\ depression\ (Dennis\ et\ al, 2017)\ 9\%\ or\ (0.9)$

$Q_1 = 1 - P_1 = 1 - 0.9 = 0.1$

$P_1 - P_2 = 0.9\text{-}0.7 = 0.2$

$P = Proporsi\ Total = \frac{P_1 + P_2}{2} = \frac{0.9 + 0.7}{2} = 0.8$

$Q_{\_} = 1 - P = 1 - 0.8 = 0.2$

Data was gathered with questionnaires, filled out by the mothers themselves in the presence of the researcher. The variable was categorized with high risk as follows: (i) a patient demographic (age of marriage <19 years, occupation non-working mother, education <basic-9 years, and monthly family income <IDR 3,000,000,-); (ii) physical activity (sedentary); (iii) body mass index (<18,5 and >25,0), (iv) cigarette smoke high exposure (husband smoke activity, history of active smoking in the past, the minimum one-year daily smoke exposure); (v) prenatal depression using Edinburgh Prenatal Depression Scale (EPDS Score≥10). To determine the relationship between prenatal depression and all risk factors using a chi-square test, after conducting the normality test. To calculate all the significant risk factors simultaneously using multiple logistic regression. All variables are entered in the multiple logistic analysis, as assume all the possibilities may have influenced or contributed to prenatal depression. All the study procedure were approved by the Ethic Commite of Sekolah Tinggi Ilmu Kesehatan Nani Hasanuddin Makassar no. 674/STIKES-NH/KEPK/VI/2021.

3. Results and Discussion

3.1. Results

According to the measurement, a total of 79 subjects (pregnant mothers) participated in the study, and four subjects were unable to continue to analysis due to incomplete observation. The presence of prenatal depression is 54.4%. The risk is likely to be steady compared to an earlier study [11]. Mothers who experience major prenatal depression symptoms are vulnerable to more disadvantages during childbirth and the breastfeeding period.

The subjects were classified according to the recommended marriage age of 19 years or older in Indonesia, where more than two-thirds of mothers marry in their teens. Early marriage is a red flag that there is a problem with public awareness of the risks associated with early reproduction. Additionally, the data indicate that primary and secondary education dominate the mother's educational attainment, which is enabled by the high rate of early marriages, as many women choose not to continue their education or do not complete high school. This may impose an additional demographic burden on mothers in terms of acquiring the necessary knowledge and cultivating an insightful mindset. As a result, the risk of maternal ignorance about pregnancy readiness, childbirth, and other maternity issues is increased. The data are quite linear about the preceding two characteristics, indicating that mothers' primary occupation is that of housewives. This is almost certainly due to low education, which results in limited employment opportunities, as

well as the changing role of pregnant women, which prevents mothers from working or continuing their education. The Pampang Public Health Center's research area in Makassar City is classified as a lower-middle class Sub-Urban characteristic. Due to the population's characteristics and dense settlements, this area is classified as a geographical deprivation pocket that is health vulnerable. According to data, more than 80% of families earn less than IDR 3,000,000 per month. The majority of families' (husbands') non-permanent jobs in manufacturing, online transportation, small trades, and construction are to blame. This burden has increased significantly since the pandemic of 2019-2021, which resulted in the indefinite layoff of many household heads. Maternal BMIs were classified as high risk in two-thirds of cases (ie underweight, overweight, and obese). The BMI has a significant effect on the amount of weight gained during pregnancy. Sleep disorders impair sleep duration during the third trimester of pregnancy, with 64.4 percent of mothers sleeping less than 8 hours, impairing mothers' sleep quality while breastfeeding. At 41.8 percent, less than half of total respondents engage in active physical activity; this is exacerbated by the fact that 78.5 percent of total subjects are exposed to cigarette smoke. Taking everything into account, the risk factors are inextricably linked, which may contribute to the increased prevalence of prenatal depression, which has continued to rise into the postpartum period. Four characteristics have a statistically significant correlation with prenatal depression, according to the Chi-square test ($p<0.05$). All four variables (marital age 0.039; sleep duration 0.045; physical activity 0.023; and cigarette exposure 0.001) were entered into the regression model (Table 1).

Table 1. Respondent Characteristic and Bivariate Analysis Result

Characteristics	Prenatal Depression		Total		P OR (95%CI)
	Symptoms (+) N (%)	*Symptoms (-) N (%)*	*N*	*%*	
Marital Age					
<19 years	13 (76.5)	4 (23.5)	17	21.5	<0.039
≥19 years	30 (48.4)	32 (51.6)	62	78.5	3.4 (1.01-11.01)
Education					
Basic	39 (56.5)	30 (43.5)	69	87.3	0.327
Middle-Higher	4 (40)	6 (60)	10	12.7	0.5 (0.13-1.89)
Occupation					
Non-Working	40 (54.1)	34 (45.9)	74	93.7	0.796
Working Mother	3 (60)	2 (40)	5	6.3	0.7 (0.12-4.97)
Family Income					
<IDR 3,000,000	38 (56.7)	29 (43.3)	67	84.8	0.335
≥IDR 3,000,000	5 (41.7)	7 (58.3)	12	15.2	1.8 (0.52-6.37)
Body Mass Index					
At Risk	31 (51.7)	29 (48.3)	60	75.9	0.381
Healthy	12 (63.2)	7 (36.8)	19	24.1	0.6 (0.21-1.80)
Sleep Duration					
<8 hour	32 (62.7)	19 (37.3)	51	64.6	<0.045
≥8 hour	11 (39.3)	17 (60.7)	28	35.4	2.6(1.0-6.71)
Physical Activity					
Sedentary	30 (65.2)	16 (38.8)	46	58.2	<0.023
Moderate-High	13 (39.4)	20 (60.6)	33	41.8	2.8(1.14-7.27)
Cigarette Exposure					
High	40 (65.4)	22 (35.5)	62	78.5	<0.001
Low	3 (17.6)	14 (82.4)	17	21.5	8.48(2.19-32.7)

Normality Test One Kolmogorov-Smirnov $p>0.200$; *Chi square test $p<0.05$

Following the completion of all four positive correlations, the regression model is presented below (Table 2). All independent variables accurately predict prenatal depression by 83.7%. After calculating the value, it was determined that cigarette exposure was the most influential risk factor in predicting prenatal depression. This means that women with high exposure to smoking, a husband who has smoked actively in the last year, or a mother who smoked before pregnancy are at the highest risk of developing prenatal depression.

Table 2. Multivariate Analysis Result

Variable	Sig*	OR	95% CI for OR	
			Lower	Upper
Constant	0.001	0.002		
Marital Age	0.264	2.113	0.569	7.844
Physical Activity	0.121	2.242	0.809	6.213
Sleep Duration	0.132	2.248	0.784	6.446
Cigarette Exposure	0.019	5.488	1.315	22.895

3.2. Discussion

The prevalence of depressive symptoms in this study is quite high, representing the sub-urban deprivation area. The characteristics of sub-urban areas are typically the same. From education, marriage age, and occupation, concentrated in the dense urban commonly concentrated in developing countries. The study's findings indicated that adolescent age predominated over marriage age, implying that the physical readiness of the mother's reproductive organs for pregnancy and breastfeeding was not optimal in healthy and biologically prepared quotes. A young marriage age, for example, contributes to an earlier onset of motherhood. The maturation of parents varies between adolescence and adulthood. Marrying at a young age requires women to prepare to give birth earlier than other women. Age is a proxy for physical maturity and the reproductive organs' readiness to undergo the maternal process. While pregnancy and young age are undoubtedly risky physiologically, age is directly proportional to the ability to manage emotions caused by living materials psychologically. Numerous maternal burdens must be carried by adolescents, who may prefer to spend their teenage years enjoying themselves rather than completing household chores and caring for infants. Even more, underage marriages forced them to abandon their studies due to the difficulties associated with pregnancy. After death, marriage abruptly extinguishes their passion for being a wife and mother. Due to her lack of education, this condition also affects a woman's ability to find a promising job. Parenthood eventually became a daily routine consisting of cleaning the house, raising children, and serving their husbands. With limited economic capacity, a homemaker who already has a heavy daily workload is prone to fatigue. Not to mention the physical state of pregnancy, particularly in the second and third trimesters, which is strongly associated with anxiety [33].

In this study, mothers who were at risk for physical inactivity had a higher risk of prenatal depression than mothers who were actively engaged. Healthy movement is critical for maintaining vitality during pregnancy, as there are numerous risks associated with childbirth, including prolonged labor, preeclampsia, and bleeding. Heavy-duty movement is limited when pregnancy reached the second and third trimesters. The disability to move with increasing fetal and maternal weight resulted in pelvic pressure and low back pain. Mothers who are unable to overcome the limitations strictly risk impaired labor progress [34,35]. Performing such regular physical activities as prenatal gentle yoga, swimming, and walking, increases the ability of the body and mind to struggle with pain during birth [36]. Mothers with high confidence in regulating physical activity are less likely to experience anxiety, either during labor or postpartum period [37]. Physical and psychological changes that occur during pregnancy can be managed with an exercise program [27]. The distinction between physical exercise and physical activity is well-defined and concise. Physical activity is defined as any movement generated by skeletal muscles that results in energy

expenditure, whereas physical exercise is a subset of physical activity; it is planned, structured, and iterative, to improve or maintain physical condition. Physical activity typically decreases during pregnancy. Physical activity has numerous benefits for pregnant women, including reducing low back and pelvic pain, increasing metabolic and cardiopulmonary capacity, and decreasing the risk of gestational diabetes. It also aids in the delivery process, maintains the mother's physical condition, reduces fatigue during daily activities, regulates weight gain, alleviates anxiety and depression, and improves mood [38,39]. In a study conducted by Shakeel in 2018, it was discovered that women who engaged in the recommended 150 minutes of vigorous physical activity per week with moderate to vigorous physical activity had a lower risk of postpartum depression than those who were inactive during pregnancy [28].

Although the study did not establish a causal relationship between nutritional status and postpartum depression, mothers with a BMI in the excessive weight category are at risk of producing less breast milk [40] and discontinuing breastfeeding sooner [41]. Healthy nutritional status before pregnancy promotes healthy fetal development. However, nutritional status as determined by weight-height comparisons has the potential to cause physiological depression, particularly when certain nutrients are deficient, disrupting the body's metabolic balance [42]. Carbohydrates, proteins, fats, and vitamins are all macronutrient components that can be explained via metabolic pathways. Insufficient complex carbohydrate intake results in a decrease in insulin levels, and decreased insulin levels can result in depression via decreased serotonin production, as demonstrated in studies of gestational diabetes where groups on individually controlled diets had lower rates of depression than groups on standard care diets [43]. Disrupting the tryptophan stimulus in the essential amino acid (protein) class inhibits the production of serotonin, which is involved in the regulation of aggression such as anger, sadness, sleep, and fatigue [43]. Additionally, it was reported in the same study that a deficiency of Omega 3 fatty acids involved in the production of DHA is a risk factor for developing an imbalance in the regulation of the HPA axis [43]. Although the study was unable to establish a causal relationship between nutritional status and postpartum depression, mothers with a BMI of overweight to obesity are at risk of producing less breast milk volume [40,44], as well as discontinuing breastfeeding earlier [41]. Macro and micronutrient deficiency history increased the risk of weak fetal growth and birth outcomes [45]. Mothers who suffer from energy deficiency most likely experience anxiety and depression [45,46].

During pregnancy, difficulties in sleeping occur mostly at night. Physiologically pregnant women often experience sleep disorders due to pressure on the diaphragm resulting from the enlarged uterus [47]. Psychologically people who experience depression have difficulty sleeping soundly [48]. This study noted that less than eight hours of sleep duration is associated with anxiety and depression. Sleep deprivation in pregnancy is not just a lack of sleep duration but also related to sleep quality. A study of 360 mothers conducted in Iran, showed sleep deprivation emerges as a three to four times greater risk of experiencing depression symptoms [49]. Poor sleep quality leads to insomnia, and insomnia is associated with women's habits of eating at night [30] and for pregnant women, eating late is a disadvantage for fetal growth and increased the risk of postpartum obesity. Sleep disturbance at night is also commonly found in adolescent girls who experience depression [50]. Cortisol imbalances during the day and night also affect the HPA axis. Sleep onset inhibits cortisol secretion, whereas awakenings and sleep offset stimulate cortisol secretion. A correlation between cortisol secretory bursts and indices of central arousal has also been observed during waking. Sleep disruptions significantly disrupt the daily cortisol rhythm, whereas sleep deprivation and/or poor sleep quality appear to result in a small but functionally significant activation of the axis [22]. Sleep deprivation has a chronic effect on mental health [50], and during pandemics, exposure to social media is also reported to be increasing [51,52], and this is especially prevalent in adolescents.

It was discovered in this study that mothers who had a husband who smoked or had smoked had a greater risk for depressive symptom patterns. Cigarette smoke exposure has long been established as a risk factor for the developing fetus. These findings suggest that chronic exposure to cigarette smoke affects the mother's mental health in addition to the fetus. In Indonesia, up to 85% of households are exposed to cigarette smoke; eight smokers died as a result of active

smoking, while one passive smoker died as a result of exposure to other people's cigarette smoke [53]. Women are predisposed to depression and mood swings during times of hormonal transition, such as pregnancy, puerperium, and menopause, because changes in sex steroid hormones (e.g., estrogen and progesterone) and smoking have an anti-estrogenic effect on endogenous estrogen biosynthesis and bioavailability, thereby increasing the risk of postpartum depression [24]. Smoking has several adverse effects on the immune system, including increased blood levels of proinflammatory cytokines such as interleukin-1, interleukin-6, and tumor necrosis factor. Smoking also contributes to oxidative stress, as free radicals found in cigarette smoke oxidize polyunsaturated fatty acids found in cell membranes. The HPA axis is stimulated by immune system changes, increased oxidative stress, and nicotine acetylcholine receptors, and increased HPA axis activity result in increased cortisol release [24]. Although the precise mechanism by which increased cortisol causes depression is unknown, depressed patients have higher cortisol levels than non-depressed individuals [24,54]. Prenatal smoking is associated with an increased risk of postpartum depression in Japanese women, according to reports from a large-scale study. Women who quit smoking following pregnancy or who continued smoking during pregnancy had a 24% and 38% increased risk of postpartum depression, respectively, compared to women who never smoked [24]. Mothers who smoked actively in the last five years showed a significant relationship to depressive symptoms. Smoking is an uncommon thing for mothers in this region. Smoking and drinking behavior are perceived as negative, but this is their attempt to divert anxiety, disappointment, or stressful situation. Active smoking will adversely harm the fetus. Active or passive smokers increase the risk of giving adverse outcomes such as low birth weight [55].

This study was successful in identifying multiple risk factors for prenatal depression, which has been verified in earlier research [11]. This is an attempt to avoid negative consequences, particularly during childbirth and breastfeeding, that can be targeted. However, it is commendable that this study did not examine the long-term effects of prenatal depression on mothers until postpartum. As a result, additional research is warranted, particularly on the effects of prenatal melancholy on nursing quality and child growth and development.

4. Conclusion

Among all the contributing factors, smoking is the highest significant factor related to prenatal depression. Therefore, early screening for depression should be mandatory during antenatal care; this is critical for preventing future breastfeeding difficulties, particularly for at-risk mothers (mothers with active smoke exposure, teenage mothers, low physical activity, and who have difficulty sleeping).

Declaration

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