



Investigating the Relationship Between COVID-19 Stress in Pregnant Women and Mode of Delivery, APGAR Score, and Anthropometric Indices of Newborns

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Abstract:

Background: The COVID-19 pandemic led to a wave of anxiety and stress in all segments of society, especially among pregnant women. Stress poses a significant health concern for pregnant women, potentially impacting maternal and fetal well-being.

Aim: This study aims to explore the relationship between COVID-19 stress in pregnant women and the mode of delivery, APGAR score, and anthropometric indices of newborns.

Methods: A cross-sectional study was conducted in 2021, employing a survey method on 195 pregnant women who sought delivery at 22 Bahman Hospital in Khaf. Data collection involved the use of the standard COVID Stress Scale (CSS). SPSS-22 software was utilized for the analysis, employing Pearson correlation coefficient and multiple linear regression tests at a significance level of 0.05.

Results: Pregnant women who underwent cesarean sections exhibited significantly higher levels of COVID-19-related stress compared to those who had natural deliveries ($p < 0.001$). A significant negative correlation was observed between the APGAR scores in the first and fifth minutes and the anthropometric indices (weight, length, and head circumference) of newborns concerning COVID-19 stress ($p < 0.001$). Moreover, maternal stress emerged as a predictor for the type of delivery, APGAR scores, length, and head circumference of newborns ($p < 0.001$).

Conclusion: The study underscores the adverse impact of COVID-19 stress on maternal pregnancy outcomes, particularly leading to elevated cesarean section rates. The substantial influence of this stress on the APGAR score and anthropometric indices of newborns highlights the significance of implementing screening, counseling, and stress reduction education for pregnant women during the COVID-19 pandemic and beyond.

Keywords: Stress, COVID-19, Delivery, APGAR score, Anthropometric, Newborns, Women, Pregnancy.

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1. INTRODUCTION

In January 2020, the World Health Organization officially declared the COVID-19 pandemic as a global public health emergency [1, 2]. Health experts worldwide have stressed that the impact of the pandemic extends beyond physical health, affecting the mental well-being of people and giving rise to various levels of anxiety, depression, and stress disorders [3, 4].

COVID-19 stress, also known as COVID-19 Stress Syndrome (CSS), refers to the psychological distress and anxiety experienced by individuals as a result of the COVID-19 pandemic. It encompasses various interconnected elements, including fear of SARS-CoV-2 infection, concern about the socio-economic impacts of the pandemic, fear of foreigners as potential sources of infection, and pandemic-related compulsive behaviors, such as excessive checking and reassurance-seeking. This syndrome is characterized by a range of symptoms, including worry, recurrent and distressing thoughts, and preoccupation with the implications of the stressor. It has been associated with factors, such as younger age, female gender, unemployment, and low educational attainment [5-8].

Research conducted in different countries indicates a correlation between the pandemic and the prevalence of depressive, anxiety, and stress disorders across different demographic groups [9, 10]. These psychological effects have had a significant impact on society as a whole, particularly on vulnerable populations, such as pregnant women [11].

Pregnancy is a crucial period in the life of a woman, as it profoundly influences her physical, mental, and social health. Pregnant women are more susceptible to mental disorders like depression, anxiety, and stress [7, 12]. The World Health Organization has identified these conditions during pregnancy as risk factors for postpartum depression, which affects approximately 10-15% of women within the first year after giving birth [8, 13]. Consequently, the failure to diagnose and treat depression, anxiety, and stress in expectant mothers can have adverse effects on the fetus, including low birth weight, elevated stress hormone levels, and developmental issues [14, 15].

Emotional states and anxiety in pregnant women can impact fetal development through the release of chemicals like acetylcholine and epinephrine, which are transmitted to the fetus and increase fetal movements. Long-term stress can result in more severe fetal movements and premature birth, leading to complications, such as anemia, hyperactivity, excessive mobility, and poor nutrition [16].

Amidst the pandemic, various population groups, including pregnant women, were exposed to heightened levels of vulnerability and trauma. The unfamiliarity surrounding the virus, coupled with limited information on transmission, risk factors, mortality rates, and the effects on pregnancy and fetal development, can pose risks to both physical and mental health. Stress, anxiety, and depression may increase among pregnant women due to

the impact of COVID-19, potentially affecting the development of the baby [17, 18].

Studies have shown higher levels of stress, anxiety, and depression in pregnant women during the COVID-19 pandemic compared to before the outbreak [19]. Research conducted in Turkey found that the pandemic lengthened anxiety and depression symptoms in pregnant women [20]. In Iran, few studies have focused on the impact of the COVID-19 pandemic during pregnancy and the subsequent psychological disorders with it. In this regard, a study conducted in Iran confirmed the effect of COVID-19 stress on the development of infants compared to the pre-pandemic period [21]. The new environmental conditions created by the COVID-19 pandemic led to a wave of anxiety and stress in all segments of society, especially pregnant women. Physiological changes in the immune, heart, and pulmonary systems during pregnancy make these people more susceptible to respiratory viruses than other women [22], which is why there are concerns about the consequences of high levels of stress caused by coronavirus on pregnant women [23] and newborns [24]. Given the vacuum of studies in this area and the importance of examining the impact of COVID-19 stress on the development of infants, this study aims to explore the relationship between COVID-19 stress and the mode of delivery, APGAR score, and anthropometric indices of newborns in pregnant women who sought delivery at 22 Bahman Hospital in Khaf.

2. MATERIALS AND METHODS

2.1. Study Design and Setting

This descriptive-analytical cross-sectional study was conducted in 2021, employing a survey method on 195 pregnant women who sought delivery at 22 Bahman Hospital in Khaf. In this study, after approving the research project and obtaining approval from the Ethics Committee in research at the Mashhad University of Medical Sciences, the researcher received a written introduction from the University and presented it to the relevant authorities at the 22 Bahman Hospital.

2.2. Study Participants and Sampling

After explaining the objectives of the study and obtaining consent to participate in the study, all pregnant women who had visited the study for childbirth were examined. Data collection was done for three months in 2021 in the maternity ward of the hospital. The researcher who was in charge of data collection was one of the midwifery personnel working in this maternity hospital and collected data based on the criteria of inclusion and exclusion of the study. The inclusion criteria for entry into the study were: consent to participate in the study, pregnant women with a live baby, ages 18 to 35, and singleton pregnancy. On the other hand, having respiratory symptoms with suspicion of COVID-19, the presence of known complications in pregnancy according to the gynecologist, the use of neurological and psychiatric drugs, the presence of anxiety disorders and depression diagnosed according to the neurologist and psychiatrist, a

positive PCR test, and failure to fully answer the questions of the questionnaire were considered exclusion criteria in this study.

2.3. Data Collection Tool and Technique

The data were collected using a two-part questionnaire containing demographic information (age, employment status, education level, family income) and the Covid Stress Scale (CSS). The questionnaire was completed in person by midwifery personnel working in the hospital maternity ward with questions from pregnant women when visiting the maternity ward. The type of delivery, APGAR score, and anthropometric indicators of the born baby were also recorded in the same questionnaire.

The coronavirus stress scale, or COVID Stress Scale, is a self-reported scale for assessing the stress associated with the pandemic, including fear of risk and covid-19, fear of socio-economic consequences, xenophobia, fear of contamination, traumatic stress symptoms, and mandatory checks designed by Taylor *et al.* in 2020. The 36-question questionnaire is ranked on a five-degree Likert scale from 0 to 4 (never to almost always). This scale was first translated into Persian and returned to English by Khosravani *et al.* (2021). Then, this translation was compared to the original English version so that no contradiction was observed between the translated and the original English version. After these processes, the final Persian version of the scale was evaluated for 20 patients with obsessive-compulsive disorder (OCD) and 20 patients with autism spectrum disorder to test the understandability of cases, which was understandable to

all patients [25].

The data were analyzed using the SPSS statistical software version 22. First, the availability of normal data distribution was examined using the coefficients of tilt and strain, and due to the availability of normal data distribution, statistical tests of Pearson correlation (to examine the relationship between research variables) and multiple linear regression (to determine the role of maternal stress in maternity type variables, first and fifth minute APGAR and anthropometric indicators of birth infants) were used. The data were analyzed at a significant level of 0.5.

3. RESULTS

In this research, 195 pregnant women referred to the maternity hospital of 22 Bahman Khaf Hospital were examined. The minimum age was 18 years, the maximum age was 35 years, and their average age was 27.90 ± 4.04 years. Most of the studied women were housewives (39.5%), had a university education (42.6%), and had a monthly income of 5-10 million tomans (44.6%). The type of delivery of most of the investigated women was natural (67.7%) (Table 1).

Based on the results, the average APGAR score in the first and fifth minutes was 5.55 ± 1.14 and 8.06 ± 0.93 , respectively. The average weight and length of neonates at birth was 2314.36 ± 624.95 grams and 44.21 ± 4.83 cm. The average head circumference of neonates at birth was 32.18 ± 2.13 cm, and the average stress score caused by COVID-19 in the studied women was 1.85 ± 0.84 (Table 2).

Table 1. Demographic characteristics of the studied women.

Variable		Frequency	Percent
Occupation	Homemaker	77	39.5
	Employed	60	30.8
	Self-employed	58	29.7
Education	illiterate	71	36.4
	non-academic	41	21
	academic	83	42.6
Monthly income (million tomans)	≤ 5	62	31.8
	5-10	87	44.6
	> 10	46	23.6
Type of delivery	Natural	132	67.7
	Cesarean	63	32.3

Table 2. Mean and standard deviation of APGAR score and anthropometric indicators of newborns at birth and stress caused by COVID-19 in the examined women.

Variable	Lowest Score	Highest Score	Mean	Standard Deviation	Skewness	Kurtosis
APGAR first minute	4	8	5.55	1.14	0.15	- 0.82
APGAR 5th minute	5	9	8.06	0.93	0.96-	0.56
weight (gram)	1500	3500	2314.36	624.95	0.01	- 1.43
length (cm)	38	55	44.21	4.83	0.54	- 1.04
head circumference (centimeters)	29	36	32.18	2.13	0.44	- 1.07
Stress	0.39	3.58	1.85	0.84	0.29	- 0.87

Table 3. Correlation between type of delivery, first and fifth minute APGAR and anthropometric indices of newborns with the level of stress caused by COVID-19.

Variable	Fear of Danger	Fear of Socio-economic Results	Xenophobia	Fear of Contamination	Symptoms of Traumatic Stress	Compulsory Checking	Stress in General
Type of delivery	0.37*	0.44*	0.40*	0.46*	0.40*	0.35*	0.44*
APGAR first minute	- 0.28*	- 0.31*	-0.29*	- 0.36*	- 0.32*	-0.25*	- 0.33*
APGAR 5th minute	- 0.34*	-0.34*	- 0.42*	-0.31*	-0.33*	- 0.40*	- 0.39*
weight (gram)	- 0.33*	- 0.38*	- 0.38*	- 0.43*	- 0.38*	- 0.28*	-0.40*
length (cm)	- 0.37*	- 0.43*	- 0.43*	- 0.51*	-0.44*	-0.35*	-0.46*
head circumference (centimeters)	- 0.26*	- 0.30*	- 0.35*	-0.36*	- 0.30*	-0.23*	-0.33*

Note: $p < 0.001$ *

Table 4. Regression coefficients related to the impact of stress caused by COVID-19 in pregnant mothers on the variables of delivery type, first and fifth-minute APGAR score and anthropometric indices of newborns.

Variable	Non-standard Coefficient		Standard Coefficient	t value	Significance Level	Correlation Coefficient	Coefficient of Determination
	B value	Standard Error	β value				
Constant	3.45	1.13	-	3.05	0.003	0.63	0.37
Cesarean delivery	0.59	0.16	0.33	3.77	<0.005		
APGAR first minute	0.08	0.06	0.1	1.33	0.18		
APGAR 5th minute	-0.32	0.05	-0.36	5.89	<0.005		
Weight (gram)	0.0002	0.00	0.02	0.15	0.88		
Length (cm)	-0.10	0.02	-0.55	4.43	<0.005		
Head circumference (centimeters)	-0.12	0.04	-0.31	2.79	<0.006		

Pearson's correlation test showed that there is a positive and significant relationship between cesarean delivery and stress caused by COVID-19 in general and its components ($P < 0.001$). In other words, the amount of stress caused by COVID-19 was higher in women who had a cesarean delivery than in women who had a normal delivery. A negative and significant relationship was observed between APGAR scores of the first and fifth minutes and anthropometric indices (weight, length and head circumference) of newborns with stress caused by COVID-19 in general and its components ($P < 0.001$). This means that in pregnant women whose stress level of COVID-19 was lower, the first and fifth-minute Apgar scores, weight, length, and head circumference of their babies were higher (Table 3).

Multiple linear regression was used to investigate the effect of stress on the variables of delivery type, first and fifth-minute APGAR and anthropometric indices of newborns. The results of the mentioned test showed that the stress caused by COVID-19 in pregnant mothers is between the type of delivery ($P < 0.005$). Also, the stress caused by COVID-19 in pregnant mothers was the predictor of APGAR scores of the fifth minute, length and head circumference of neonates ($P < 0.005$) (Table 4).

4. DISCUSSION

Stress management is critical in providing health services to pregnant mothers to improve the health of

mothers and babies. The present study aimed to determine the relationship between the stress caused by COVID-19 and the type of delivery, APGAR score, and anthropometric indices of newborns at birth in pregnant women referring to the maternity hospital of 22 Bahman Khaf Hospital.

The findings of the present study showed that the amount of stress caused by COVID-19 was higher in women who had a cesarean delivery than in women who had a normal delivery. Neonates of pregnant mothers who had higher levels of stress due to COVID-19 had lower first and fifth-minute APGAR scores, weight, length and head circumference than other neonates. Also, other findings indicated that the stress caused by COVID-19 in pregnant mothers is the predictor of the type of delivery of the mothers, fifth-minute APGAR scores, and length and head circumference of the neonates.

In the explanation of this research finding, it can be mentioned that the birth process is always accompanied by stress. However, when another stressful factor, such as the stress caused by the coronavirus disease, is added to the stress of pregnancy and childbirth, the mental and emotional conditions of the pregnant woman worsen. This issue has probably affected the type of delivery of the pregnant woman as well as the anthropometric indices of the newborns.

Also, in explaining this research finding, it can be

mentioned that COVID-19 is associated with increased anxiety and stress in pregnant women, so pregnant women are worried about their health, their family members, and their unborn neonate during the coronavirus pandemic [8, 26]. Factors such as lack of information, fear of pregnancy and childbirth, and concerns about health and family contribute to this stress [26]. These stressors have been associated with negative pregnancy outcomes and labor complications, ultimately leading to a higher likelihood of cesarean delivery [26, 27].

Research conducted by Mehdizadehkashi *et al.* (2021) supports these findings, showing a correlation between high-stress levels during the pandemic and an increased rate of cesarean delivery [28]. Similarly, Bahrami *et al.* (2013) found that higher levels of stress in pregnant women are associated with a higher probability of elective cesarean delivery [29]. Other studies by Halvorsen *et al.* (2008) and Nerum *et al.* (2006) have demonstrated that pregnant women with higher stress and anxiety are more likely to prefer elective cesarean sections due to their fear of natural childbirth [30, 31].

Contrary to the findings of the present study, a study by Sinaei *et al.* (2021) revealed no significant relationship between perceived stress and the type of delivery. The high rate of cesarean section among pregnant women was attributed to factors, such as the opinion of the doctor, clinical conditions, and the preferences of pregnant women [32]. This discrepancy could be attributed to variations in geographical environments, cultural and social conditions, as well as the mental and physical state of the participants. Additionally, the previous study did not specifically examine stress related to COVID-19, focusing instead on general stress levels.

The results of the present study showed that there is a negative and significant relationship between the Apgar score of the first and fifth minutes with the stress caused by COVID-19 in general and its components. In other words, in mothers whose neonates had higher Apgar scores in the first and fifth minutes, the level of stress caused by COVID-19 was significantly lower. The study findings indicated that stress caused by COVID-19 in pregnant women can predict the APGAR scores of newborns. This finding was supported by the study conducted by Nodoushan *et al.*, which identified COVID-19-related stress as a predictor of APGAR scores [21]. Elevated levels of cortisol and other adrenal hormones due to high levels of COVID-19 stress can potentially lead to decreased APGAR scores in the first and fifth minutes after birth [14]. Consistent with these findings, Bahrami *et al.* (2013) found a significant relationship between maternal depression and stress and APGAR scores, with lower scores observed in the group of mothers with depression and stress disorders [29].

Similarly, the study conducted by Marcus *et al.* (2009) demonstrated a negative and significant correlation between newborn APGAR scores and maternal anxiety, stress, and depression [33]. In contrast, studies by Keenan *et al.* (2007), Suri *et al.* (2007), and Diego *et al.* (2009) did not find a relationship between newborn APGAR scores

and stress or depression disorders [34-36]. The differences in sample characteristics, as well as the focus on stress caused by COVID-19 in pregnant women, could explain the discrepancies between these findings and the results of the present study. Additionally, the studies by Keenan and Diego focused on severely depressed mothers, while the study of Suri *et al.* specifically examined teenage mothers.

The relationship between the stress caused by COVID-19 and birth weight in neonates was found to be negative and significant in the present study. Mothers whose neonates had a higher birth weight experienced significantly lower levels of stress caused by COVID-19. This suggests that increased stress and decreased mental health in pregnant women during the COVID-19 pandemic can contribute to the occurrence of premature and unhealthy births. A study by Nodoushan *et al.* on 560 pregnant women also found a correlation between the stress levels of mothers during the pandemic and the weight of their neonates [21]. In contrast, a study conducted in Australia showed contradictory results, indicating that stress during pregnancy caused by COVID-19 could not predict the weight of the baby [37]. This discrepancy could be attributed to geographical differences, as Australia implemented strict measures to prevent the entry of the coronavirus, while Iran did not have such strict entry requirements, resulting in more COVID-19 cases in the community.

Additionally, it should be noted that malnutrition and psychological anorexia in mothers with stress and depression can lead to lower maternal weight gain during pregnancy, and, as a result, lower birth weight of the baby is important [38, 39]. Maternal nutritional status is one of the most important parameters for maternal weight gain during pregnancy [40, 41]. Additionally, mothers who suffer from stress and depression have higher levels of cortisol and norepinephrine. Cortisol causes a reduction in uterine blood flow, which limits the supply of oxygen and nutrients to the fetus, leading to neonatal weight loss at birth and other neonatal disorders [41, 42].

In line with this finding of the present study, the results of the study by Bahrami and colleagues (2013), Skouteris *et al.* (2009), and Diego *et al.* (2009) showed that the possibility of a low-birth-weight neonate is more likely in mothers with high levels of anxiety, stress, and depression [29, 34, 43]. Contrary to this finding of the present study, the results of the studies by Keenan *et al.* (2007) and Suri *et al.* (2007) showed that there is no relationship between stress and depression during pregnancy and weight loss in newborns [35, 36]. To interpret this discrepancy in the findings, we can refer to the following: the study of pregnant mothers with different age groups, history of pregnancy, previous childbirth, number of children, different geographical environments, cultural and social conditions, and different mental, psychological, and physical conditions.

Further, the results of the current study showed that there is a negative and significant relationship between neonatal length and head circumference at birth and exposure to COVID-19 infection and its components in

general. In other words, for mothers whose neonates had a greater length, the level of stress caused by COVID-19 in them was significantly lower. The stress caused by the coronavirus infection for pregnant women also affected the size and head circumference of the baby. In this context, a similar study showed that the length and head circumference of the baby are related to the stress level of the mother during the corona period [34]. Poor appetite and stress-related malnutrition in pregnant women may also result in the mother not gaining weight properly and ultimately reducing the length and head circumference of the baby at birth [39]. Consistent with this finding, results from a study by Field *et al.* (2009) showed a significant association between stress and depression during pregnancy and baby size at birth [40]. Baharami *et al.* (2012) showed that average birth size was not significantly associated with depression and stress disorders [29]. Among the reasons for the difference in findings with the present study, we can mention the following: the study of different groups of pregnant women in different trimesters of pregnancy, the demographic differences of the investigated pregnant women, different geographical conditions in the investigated studies, conducting studies before the covid-19 pandemic, and the nutritional status of pregnant mothers in the investigated studies.

Contrary to the findings of the present study, the study of Pearson *et al.* (2023), which was conducted on 195 pregnant mothers, showed that the stress caused by COVID-19 during the pregnancy of the mother does not predict changes in birth outcomes, including birth weight, head circumference, and APGAR score [37]. This contradiction can be a result of the geographical differences between the two studies because the aforementioned study was conducted in Canada, where the frequency of the epidemic and the death rate due to COVID-19 was lower than in Iran, which is one of the countries. It had a high death rate compared to the population. Also, in confirmation of the findings of the present study, the results of the study by Bahrami (2012), Marcus (2009), Diego (2009), and Dancause (2011) showed that there is a significant relationship between stress, anxiety, and depression of the pregnant mother and the head circumference of the neonate [29, 33, 34, 44]. The head circumference of the neonate is a strong factor related to the growth and weight of the brain, so the brain growth of the neonate is related to IQ during childhood and adulthood and cognitive function [33, 45]. The size of the head circumference of the baby indicates the nutritional status of the mother and the weight and brain growth of the neonate, which can be affected by the stress taken by the mother. Therefore, malnutrition due to maternal malnutrition or maternal stress is associated with decreased head size [44, 46].

5. STRENGTHS AND LIMITATIONS OF THE STUDY

Although the present study is one of the few studies that investigated the effect of stress caused by COVID-19 on the type of delivery, APGAR score, and anthropometric indicators of newborns in Iran, it has some limitations.

Due to its single-centered nature, it is not possible to generalize the data to other populations. Also, the cross-sectional nature of the study limits causal conclusions. Also, in this research, a questionnaire was used to collect data, and there is a possibility that the results of the study may be biased by self-reporting. Also, the physical condition of the participants (pain) and the time of completing the questionnaires (before delivery), which in itself increases the stress level, might have affected the responses of the subjects. Another limitation of the present study is the lack of attention to the underlying diseases of pregnant women, which was not investigated at the time of data collection, and finally, the correlation of this variable with other variables investigated in the present study was not found.

CONCLUSION

The results of the present study showed that the amount of stress caused by COVID-19 was higher in women who had a cesarean delivery than in women who had a normal delivery. As the average stress among mothers caused by COVID-19 increased, the first and fifth-minute APGAR score, weight, length, and head circumference of neonates decreased. Considering the negative effects of the stress of COVID-19 on the outcome of pregnancy in mothers (increasing the rate of cesarean section) and its effect on the APGAR score and anthropometric indicators of newborns, the necessity of screening, counseling, and training to reduce stress in pregnant mothers is revealed. Managers and health policymakers must prioritize stress management to provide health services to pregnant mothers by conducting practical programs. In addition, they should support pregnant women by providing conditions for a healthy pregnancy and reducing stress so that, finally, with the birth of healthy neonates, the health of society can be achieved. Also, policies for timely vaccination and infection control and preparing the health-treatment system for future infectious pandemics should be on the agenda of the officials.

LIST OF ABBREVIATIONS

- CSS = COVID Stress Scale
 OCD = Obsessive-compulsive Disorder

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

In terms of ethical considerations, the present study was ethical in two respects: first, all the participants volunteered to participate in the study, and secondly, keeping in mind the principles of confidentiality and secrecy, participants were assured that all information would remain confidential and that the results would be reported in a general manner. This article reports the results of a research project approved by Mashhad University of Medical Sciences with the code of ethics (IR.MUMS.REC.1401.149).

HUMAN AND ANIMAL RIGHTS

No animal were used that are the basis of this study. All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1975 Helsinki Declaration and its later amendments or comparable ethical standards.

CONSENT FOR PUBLICATION

In order to comply with ethical considerations in this research, the information of the participants was kept confidential, and other people were not able to access this information. The names and surnames of the participants were not used for data collection, and data collection was done after obtaining the code of ethics from Mashhad University of Medical Sciences.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author [R.R.] upon reasonable request.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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REFERENCES

- [1] Gorbalenya AE, Baker SC, Baric RS, *et al.* Severe acute respiratory syndrome-related coronavirus: The species and its viruses-A statement of the coronavirus study group. *BioRxiv* 2020; 2020: 937862. <http://dx.doi.org/10.1101/2020.02.07.937862>
- [2] Mirzaei A, Raesi R, Saghari S, Raei M. Evaluation of family caregiver burden among COVID-19 patients. *Open Public Health J* 2020; 13(1): 808-14. <http://dx.doi.org/10.2174/1874944502013010808>
- [3] McBride O, Murphy J, Shevlin M, *et al.* Monitoring the psychological impact of the COVID-19 pandemic in the general population: An overview of the context, design and conduct of the COVID-19 Psychological Research Consortium (C19PRC) Study. *PsyArXiv* 2020; 2020: wxe2n. <http://dx.doi.org/10.31234/osf.io/wxe2n>
- [4] Raesi R, Moradi M, Saghari S, Gholami MH, Nazar E, Bokaie S. Impact of virtual-based resilience training on perceived stress in family caregivers of COVID-19 patients. *Arch Adv Biosci* 2023; 14(1): 1-9.
- [5] Taylor S. COVID stress syndrome: Clinical and nosological considerations. *Curr Psychiatry Rep* 2021; 23(4): 19. <http://dx.doi.org/10.1007/s11920-021-01226-y> PMID: 33660068
- [6] Raesi R, Abbasi Z, Raei M, Hushmandi K. The relationship between the incidence of COVID-19 with the underlying diseases in hospitalized patients. *EBNESINA* 2022; 24(3): 75-80.
- [7] Abbasi Z, Saghari S, Nashtifani AH, Daneshi S, Hushmandi K, Raesi R. Frequency distribution of depression and its associated factors among pregnant women during the COVID-19 pandemic. *Open Public Health J* 2023; 16(1): e18749445252830. <http://dx.doi.org/10.2174/0118749445252830231026060947>
- [8] Kavooosi J, Hushmandi K, Orouei S, Raesi R. Prevalence of Hypochondriasis and its Association with Stress, Anxiety, and Depression caused by the Prevalence of COVID-19 among Pregnant Women Visiting Comprehensive Health Service Centers. *Open Public Health J* 2023; 16(1)
- [9] Brooks SK, Webster RK, Smith LE, *et al.* The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *Lancet* 2020; 395(10227): 912-20. [http://dx.doi.org/10.1016/S0140-6736\(20\)30460-8](http://dx.doi.org/10.1016/S0140-6736(20)30460-8) PMID: 32112714
- [10] Raesi R, Moradi M, Saghari S, *et al.* General health subcomponents and marital satisfaction: Examining a correlation during COVID-19. *Arch Adv Biosci* 2022; 13(2): 1-10.
- [11] De Sousa A, Mohandas E, Javed A. Psychological interventions during COVID-19: Challenges for low and middle income countries. *Asian J Psychiatr* 2020; 51: 102128. <http://dx.doi.org/10.1016/j.ajp.2020.102128> PMID: 32380441
- [12] Fisher J, Tran T, La B, Kriitmaa K, Rosenthal D, Tran T. Common perinatal mental disorders in northern Viet Nam: Community prevalence and health care use. *Bull World Health Organ* 2010; 88(10): 737-45. <http://dx.doi.org/10.2471/BLT.09.067066> PMID: 20931058
- [13] Stewart DE, Robertson E, Dennis C-L, Grace SL, Wallington T. Postpartum depression: Literature review of risk factors and interventions. Toronto: University Health Network Women's Health Program for Toronto Public Health 2003; pp. 1-289.
- [14] Coll CVN, da Silveira MF, Bassani DG, *et al.* Antenatal depressive symptoms among pregnant women: Evidence from a Southern Brazilian population-based cohort study. *J Affect Disord* 2017; 209: 140-6. <http://dx.doi.org/10.1016/j.jad.2016.11.031> PMID: 27914247
- [15] Hushmandi K, Saghari S, Raesi R. Assessing the attitude of women towards pregnancy, childbirth, and child care during the COVID-19 pandemic (A Cross-sectional Study). *Open Public Health J* 2023; 16(1): e1874944-.
- [16] Akbarzadeh M, Dokuhaki A, Joker A, Pishva N, Zare N. Teaching attachment behaviors to pregnant women: A randomized controlled trial of effects on infant mental health from birth to the age of three months. *Ann Saudi Med* 2016; 36(3): 175-83. <http://dx.doi.org/10.5144/0256-4947.2016.175> PMID: 27236388
- [17] Lee DTS, Sahota D, Leung TN, Yip ASK, Lee FFY, Chung TKH. Psychological responses of pregnant women to an infectious outbreak: A case-control study of the 2003 SARS outbreak in Hong Kong. *J Psychosom Res* 2006; 61(5): 707-13. <http://dx.doi.org/10.1016/j.jpsychores.2006.08.005> PMID: 17084150
- [18] Raesi R, Khalesi N, Safavi M, Mirzaei A, Alimohammadzadeh K. Identifying the outcomes of healthy lifestyles in the Post-COVID-19 Era. *Arch Adv Biosci* 2023; 14(1): 1-14.
- [19] Berthelot N, Lemieux R, Garon-Bissonnette J, Drouin-Maziade C, Martel É, Maziade M. Uptrend in distress and psychiatric symptomatology in pregnant women during the coronavirus disease 2019 pandemic. *Acta Obstet Gynecol Scand* 2020; 99(7): 848-55. <http://dx.doi.org/10.1111/aogs.13925> PMID: 32449178
- [20] Durankuş F, Aksu E. Effects of the COVID-19 pandemic on anxiety and depressive symptoms in pregnant women: A preliminary study. *J Matern Fetal Neonatal Med* 2022; 35(2): 205-11. <http://dx.doi.org/10.1080/14767058.2020.1763946> PMID: 32419558
- [21] Nodoushan RJ, Alimoradi H, Nazari M. Spiritual health and stress in pregnant women during the Covid-19 pandemic. *SN Compr Clin Med* 2020; 2(12): 2528-34. <http://dx.doi.org/10.1007/s42399-020-00582-9> PMID: 33083694
- [22] Yang H, Wang C, Poon LC. Novel coronavirus infection and

- pregnancy. *Ultrasound Obstet Gynecol* 2020; 55(4): 435-7.
<http://dx.doi.org/10.1002/uog.22006> PMID: 32134165
- [23] Wu Y-T, Zhang C, Liu H, Duan C-C, Li C, Fan J-X. Perinatal depression of women along with 2019 novel coronavirus breakout in China. 2020.
<http://dx.doi.org/10.2139/ssrn.3539359>
- [24] Assiri A, Abedi GR, Al Masri M, Bin Saeed A, Gerber SI, Watson JT. Middle East respiratory syndrome coronavirus infection during pregnancy: A report of 5 cases from Saudi Arabia. *Clin Infect Dis* 2016; 63(7): 951-3.
<http://dx.doi.org/10.1093/cid/ciw412> PMID: 27358348
- [25] Khosravani V, Asmundson GJG, Taylor S, Sharifi Bastan F, Samimi Ardestani SM. The Persian COVID stress scales (Persian-CSS) and COVID-19-related stress reactions in patients with obsessive-compulsive and anxiety disorders. *J Obsessive Compuls Relat Disord* 2021; 28: 100615.
<http://dx.doi.org/10.1016/j.jocrd.2020.100615> PMID: 33354499
- [26] Corbett GA, Milne SJ, Hehir MP, Lindow SW, O'connell MP. Health anxiety and behavioural changes of pregnant women during the COVID-19 pandemic. *Eur J Obstet Gynecol Reprod Biol* 2020; 249: 96-7.
<http://dx.doi.org/10.1016/j.ejogrb.2020.04.022> PMID: 32317197
- [27] Mehdizadeh A, Roosta F, Chaichian S, Alaghebandan R. Evaluation of the impact of birth preparation courses on the health of the mother and the newborn. *Am J Perinatol* 2005; 22(1): 7-9.
<http://dx.doi.org/10.1055/s-2004-837738> PMID: 15668838
- [28] Mehdizadehkashi A, Chaichian S, Haghighi L, et al. The impact of COVID-19 pandemic on stress and anxiety of non-infected pregnant mothers. *J Reprod Infertil* 2021; 22(2): 125-32.
<http://dx.doi.org/10.18502/jri.v22i2.5801> PMID: 34041009
- [29] Bahrami N, Bahrami S. Correlation between prenatal depression with delivery type and neonatal anthropometric indicators. *Koomesh* 2013; 15(1): 39-45.
- [30] Halvorsen L, Nerum H, Øian P, Sørli T. Is there an association between psychological stress and request for caesarian section? *Tidsskr Nor Laegeforen* 2008; 128(12): 1388-91.
- [31] Nerum H, Halvorsen L, Sørli T, Øian P. Maternal request for cesarean section due to fear of birth: Can it be changed through crisis-oriented counseling? *Birth* 2006; 33(3): 221-8.
<http://dx.doi.org/10.1111/j.1523-536X.2006.00107.x> PMID: 16948722
- [32] Sinaei A, Abbaspoor Z, Hashemi S, Javadifar N. The relationship between perceived stress and attitude towards delivery and choosing mode of delivery among pregnant women. *Majallah-i Danishgah-i Ulum-i Pizishki-i Babul* 2018; 20(5): 61-7.
- [33] Marcus SM. Depression during pregnancy: Rates, risks and consequences--Motherisk Update 2008. *J Popul Ther Clin Pharmacol* 2009; 16(1): e15-22.
 PMID: 19164843
- [34] Diego MA, Field T, Hernandez-Reif M, Schanberg S, Kuhn C, Gonzalez-Quintero VH. Prenatal depression restricts fetal growth. *Early Hum Dev* 2009; 85(1): 65-70.
<http://dx.doi.org/10.1016/j.earlhumdev.2008.07.002> PMID: 18723301
- [35] Keenan K, Sheffield R, Boeldt D. Are prenatal psychological or physical stressors associated with suboptimal outcomes in neonates born to adolescent mothers? *Early Hum Dev* 2007; 83(9): 623-7.
<http://dx.doi.org/10.1016/j.earlhumdev.2007.01.002> PMID: 17307312
- [36] Suri R, Altshuler L, Hellemann G, Burt VK, Aquino A, Mintz J. Effects of antenatal depression and antidepressant treatment on gestational age at birth and risk of preterm birth. *Am J Psychiatry* 2007; 164(8): 1206-13.
<http://dx.doi.org/10.1176/appi.ajp.2007.06071172> PMID: 17671283
- [37] Pearson J, Fréchette-Boilard G, Baudry C, et al. Prenatal maternal stress during the COVID-19 pandemic and birth outcomes: Is the newborn spared? *Infant Behav Dev* 2023; 72: 101866.
<http://dx.doi.org/10.1016/j.infbeh.2023.101866> PMID: 37506422
- [38] Obstetrics W. Williams Obstetrics. NY, USA: McGraw-Hill Companies Inc. 2001.
- [39] Sollid CP, Wisborg K, Hjort J, Secher NJ. Eating disorder that was diagnosed before pregnancy and pregnancy outcome. *Am J Obstet Gynecol* 2004; 190(1): 206-10.
[http://dx.doi.org/10.1016/S0002-9378\(03\)00900-1](http://dx.doi.org/10.1016/S0002-9378(03)00900-1) PMID: 14749661
- [40] Field T, Diego M, Hernandez-Reif M, et al. Depressed pregnant black women have a greater incidence of prematurity and low birthweight outcomes. *Infant Behav Dev* 2009; 32(1): 10-6.
<http://dx.doi.org/10.1016/j.infbeh.2008.09.005> PMID: 19004502
- [41] Tchirikov M, Rybakowski C, Hüneke B, Schoder V, Schröder HJ. Umbilical vein blood volume flow rate and umbilical artery pulsatility as 'venous-arterial index' in the prediction of neonatal compromise. *Ultrasound Obstet Gynecol* 2002; 20(6): 580-5.
<http://dx.doi.org/10.1046/j.1469-0705.2002.00832.x> PMID: 12493047
- [42] Sandman CA, Glynn L, Schetter CD, Wadhwa P, Garite T, Chicz-DeMet A, et al. Elevated maternal cortisol early in pregnancy predicts third trimester levels of placental corticotropin releasing hormone (CRH): Priming the placental clock. *Peptides* 2006; 27(6): 1457-63.
- [43] Skouteris H, Wertheim EH, Rallis S, Milgrom J, Paxton SJ. Depression and anxiety through pregnancy and the early postpartum: An examination of prospective relationships. *J Affect Disord* 2009; 113(3): 303-8.
<http://dx.doi.org/10.1016/j.jad.2008.06.002> PMID: 18614240
- [44] Dancause KN, Laplante DP, Oremus C, Fraser S, Brunet A, King S. Disaster-related prenatal maternal stress influences birth outcomes: Project Ice Storm. *Early Hum Dev* 2011; 87(12): 813-20.
<http://dx.doi.org/10.1016/j.earlhumdev.2011.06.007> PMID: 21784587
- [45] Gale CR, O'Callaghan FJ, Bredow M, Martyn CN. The influence of head growth in fetal life, infancy, and childhood on intelligence at the ages of 4 and 8 years. *Pediatrics* 2006; 118(4): 1486-92.
<http://dx.doi.org/10.1542/peds.2005-2629> PMID: 17015539
- [46] Kramer MS. Maternal nutrition and adverse pregnancy outcomes: Lessons from epidemiology. *Nestle Nutr Workshop Ser Pediatr Program* 2005; 55: 1-10.
<http://dx.doi.org/10.1159/000082589>