SYSTEMATIC REVIEW

Stress exposure due to the COVID-19 pandemic on menstrual abnormalities: A systematic review

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ABSTRACT

Objective: COVID-19 pandemic had caused a considerable increase in stress level due to reduced human mobility, interaction, and activity. High stress levels are often associated with an adverse health outcome. Stress influences female reproduction systems, where it is an important indicator of female health. This systematic review aimed to analyze the relationship between stress levels due to the COVID-19 pandemic and the incidence of abnormal menstruation.

Materials and Methods: This systematic review was registered in PROSPERO international database (CRD42023433296). Literature search was conducted across four databases, Pubmed, Web of Science, Science Direct, and Google Scholar, with boolean AND and OR operators as keyword search assistants. Literature was searched and limited to journals published during the pandemic (2019-2023), written in English, an open access article, and meet the keywords. Literature not a research study, duplicated and limited access were not included. Inclusion to the journal was carried out by screening using PRISMA flowchart and EPHPP Assessment Tool for Quantitative Studies for the quality assessment.

Results: Nine out of 1150 journals were eligible for review. Seven studies revealed that there was a significant relationship between stress and anxiety due to the COVID-19 pandemic and the incidence of menstrual abnormalities. However, one study revealed that these changes were not significant.

Conclusion: There is a significant relationship between stress during the COVID-19 pandemic and the incidence of menstrual abnormalities.

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Highlights:

1. There is a significant higher level of stress during COVID-19 pandemic.
2. The highest menstrual abnormalities during pandemic cases were found in premenstrual syndrome and dysmenorrhea, and the lowest was found in menstrual cycle disorders (polygomenorrhea, oligomenorrhea, amenorrhoea).

INTRODUCTION

Menstrual cycle is one of vital sign on women's health.[1] Women under 30 continue to experience problems related to hormones and menstruation, especially abnormal menstruation.[2] Abnormal menstruation not only causes discomfort for women and interferes women's quality of life, it is also associated with poor health outcomes, such as an increased risk of coronary heart disease, type 2 diabetes mellitus, and cardio-metabolic diseases.[3] On the other hand, menstrual cycle has become one indicator of overall women health, although sometimes it is overlooked by several health practitioners.[1] Abnormalities in menstruation that commonly occurs are dysmenorrhea, premenstrual symptoms, menorrhagia, polymenorrhea, abnormal vaginal bleeding, amenorrhea, oligomenorrhea, and irregular menstruation.[4]

High levels of stress are often associated with adverse health outcomes. Stress can cause or exacerbate significant health problems, including cardiovascular disease, obesity, sexual dysfunction, digestive problems, and mental health conditions.[1] Stress also influences female reproduction, where stress involves the hormonal system as a system that plays a significant role. Several studies were found a relation between stress and menstrual abnormalities.[4]

COVID-19 pandemic has caused a relatively high increase in stress levels due to reduced mobility, interaction, and human activity. This situation tend to be stressful for some individuals.[5] During COVID-19 pandemic, prevalence rate of stress in general population was found to be higher, especially in women and younger age groups.[6] High levels of anxiety and stress have led to the emergence of other studies regarding the relationship between the pandemic and abnormal menstruation or disruption of the menstrual cycle. The prevalence of population experienced severe dysmenorrhea during the pandemic were higher than before pandemic occurred.[7] Based on this background, further exploration was needed in regard with the relationship between exposure to stress due to the COVID-19 pandemic and the incidence of abnormal menstruation.

MATERIALS AND METHODS

This systematic review was registered in PROSPERO international database (CRD42023433296). The research was started by determining research questions, PICO, quality assessment, data extraction, and reporting.

Table 1. PICO Question

Population	Women of childbearing age
Intervention	Stres during COVID-19 pandemic
Comparison	Stres before COVID-19 pandemic
Outcome	Menstrual abnormalities

We performed the literature search using the AND and OR boolean operators. Literature was searched and limited to journals published during the pandemic (2019-2023), written in English, an open access article, and meet the keywords. Article not a research study, duplicated and limited access were not included. Literature screening was based on the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) search flow (Figure 1). Literature that has been screened through the PRISMA method was further screened through the EPHPP Quality Assessment Tool for Quantitative Studies.

RESULTS AND DISCUSSION

We found relationship between exposure to stress due to the COVID 19 pandemic and menstrual abnormalities. The relationship was analyzed through five cross-sectional, two observational, and two retrospective study. Eight studies revealed a significant relationship between stress due to the COVID 19 pandemic and the occurrence of abnormal menstruation, and one study revealed that these changes were not significant.

Stress during the COVID-19 pandemic

COVID-19 pandemic has causes stress and generates negative emotions such as fear, anxiety, and depression for everyone, regardless of age, gender, or socioeconomic status.[8] COVID-19 pandemic also have more significant impact on women than men, both as a front liners such as doctors, nurses, midwives, as well as women who work and do not work at home.[9] Based on research that has been filtered, all respondents experienced an increase in stress levels during the COVID-19 pandemic. Decreased mood, higher anxiety, sleeping difficulty, increased stress, loneliness, and lack of concentration were found during COVID-19 pandemic.[10,11]. Women also tend to experienced one to more than one new symptoms and worsening mental health changes during COVID-19 pandemic.[12-14]

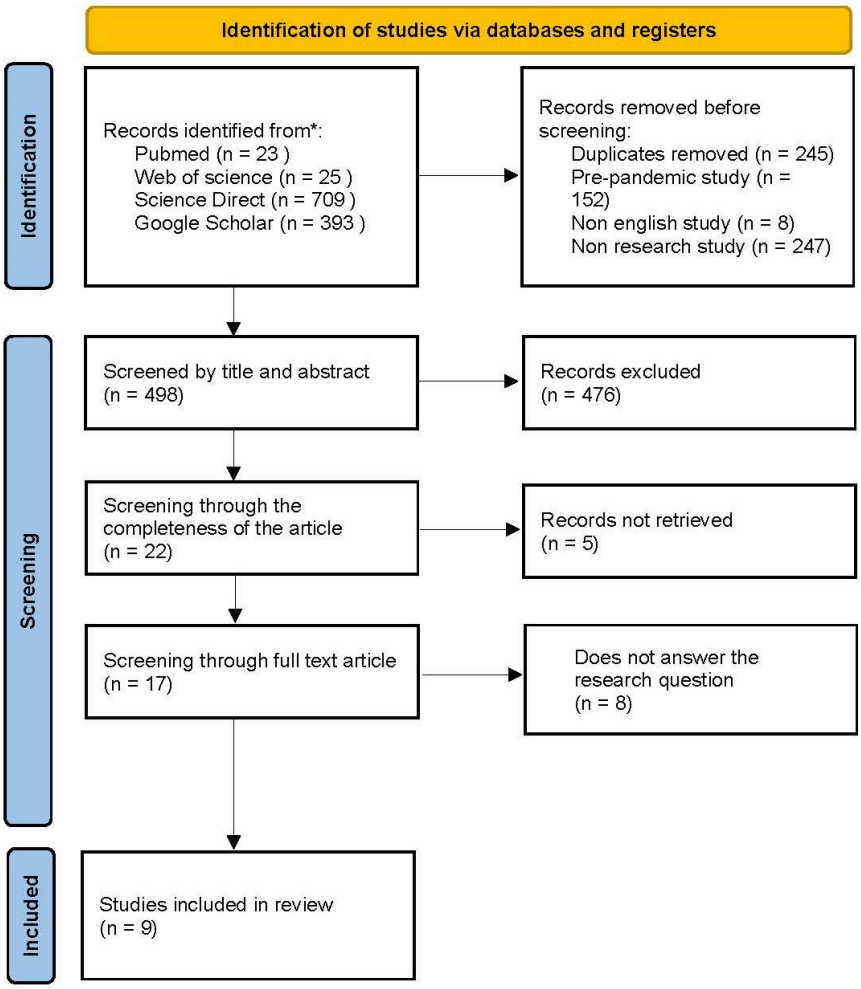

Figure 1. PRISMA Method

Table 2. Data Extraction

Author	Aims	Study criteria	Characteristics	Results
Takmaz et al., (2021)	Knowing the relationship between menstrual cycle regularity and anxiety, depression, and stress related to the COVID-19 pandemic in medical personnel.	Type: Cross-sectional Location: Turkey Sample: 925 Instrument: Questionnaire	Medical personnel with an age range of 18 to 40 years, had regular menstrual cycles for 1 year up to more before the pandemic.	Medical personnel with an age range of 18 to 40 years had regular menstrual cycles for one year up to more before the pandemic. Relationship was found between menstrual cycle regularity and anxiety, depression, and stress related to the COVID-19 pandemic in medical personnel with higher CSS and DASS-21 results compared to the group with regular menstruation ($p<0.001$).
Samo et al., (2021)	Knowing the relationship between mental health during the COVID-19 pandemic and menstrual abnormalities in female students.	Type: Cross-sectional Location: Pakistan Sample: 400 Instrument: Questionnaire	Female students aged 17-25 years have no gynecological problems and are not married.	A relationship was found between mental health during the COVID-19 pandemic and menstrual abnormalities in female students with the results 59.75% of students felt their mental health was affected by COVID-19 and 25.75% of female students felt that their menstrual cycle was affected.
Phelan et al., (2021)	Knowing the relationship between the menstrual cycle, libido and lifestyle changes to the pandemic.	Type: Observational Location: Ireland, UK, other countries Sample: 1031 Instrument: Questionnaire	Women of childbearing age aged 15-54 years	A relationship was found between the menstrual cycle during the pandemic with the result that 46% of women experienced changes in their menstrual cycle during the COVID-19 pandemic.

Payne et al., (2023)	Knowing the relationship between COVID-related stress and menstrual variables (menstrual pain, number and severity of menstrual symptoms, and menstrual pain disorders)	Type: Observational Location: USA Sample: 223 Instrument: Questionnaire	Women of childbearing age aged 18-55 years, experienced 1x menstruation in the last 3 months, did a self-report in the last 12 months.	Results showed that COVID-related stress was associated with higher rates of menstrual pain, more frequent and more severe menstrual symptoms, and greater menstrual pain disturbances.
Nguyen et al., (2021)	To determine whether the COVID pandemic is affecting ovulation and menstruation	Type: Retrospective cohort Location: UK, USA, Sweden Sample: 18076 Instrument: Questionnaire	Women who entered menstrual data from March to September 2019 and March to September 202	The results showed that fewer menstrual abnormalities occurred during the pandemic than before the pandemic. There was no independent relationship between stress and cycle disorders. However, more abnormal cycles were found in women over 45 years of age, which may indicate stress-related sensitivity during the perimenopausal state.
Medina Perucha et al., (2022)	To determine whether the COVID pandemic is affecting the menstrual cycle	Type: Cross-sectional Location: Spain Sample: 17455 Instrument: Questionnaire	Women aged 18-55 years	39.4% experienced menstrual changes since the start of the pandemic.
Maher et al., (2022)	To determine whether the COVID pandemic is affecting the menstrual cycle	Type: Cross-sectional Location: Ireland, UK, other countries Sample: 1335 Instrument: Questionnaire	Women of childbearing age and are not breastfeeding and experience amenorrhea due to pregnancy, intrauterine disorders, and implants	Results showed that there has been an increase in anxiety and the prevalence of pain during menstruation and worsening of pre-menstrual symptoms during the pandemic.
Aolymat et al., (2022)	To find relationship between dysmenorrhea, PMS, and health of the reproductive tract on anxiety, depression, and stress related to COVID-19	Type: Cross-sectional Location: Jordan Sample: 385 Instrument: Questionnaire	Medical students in Jordan over the age of 18 and unmarried	Results showed a positive Pearson correlation between mental health disorders related to COVID-19 and the severity of dysmenorrhea, PMS and reproductive health disorders ($p < 0.05$).
Garcia de leon et al., (2023)	To evaluate female reproductive and mental health on the 1st year of COVID-19 pandemic	Type: Retrospective survey Location: Columbia, Canada Sample: 4171 Instrument: Questionnaire	Women aged 25-69 years	Results found 27.8% of the respondent reported menstrual cycle disturbances, especially on respondent with higher perceived stress, depression and anxiety scales.

Menstrual abnormalities during the pandemic

Menorrhagia

The incidence of menorrhagia during the pandemic was found in four studies. Medina-Perucha et al.[15] found 7.2% of their respondents experienced an increase in bleeding. This finding was in line with a study by Samo et al.[13] which found that 15% of the respondents experienced heavy bleeding during the COVID-19 pandemic, and also in line with the research by Phelan et al.[11] who also mentioned that 28% of the respondents had menstruation for more than eight days. Higher percentage was found on a study by Maher et al.[12] which stated that 50% of their respondents felt that their menstrual volume during the pandemic had also increased.

Hypomenorrhea

Hypomenorrhea was also found during the COVID-19 pandemic. The incidence of hypomenorrhea was found in four studies. Takmaz et al.[10] found that 2.5% of their respondents experienced reduced blood volume during menstruation. This was in line with a study by Maher et al.[12] which 5.1% of their respondents experienced a reduction in menstrual days, and 5% experienced a reduction in menstrual volume. Samo et al.[13] also revealed a decrease in menstrual volume in 16.75% of their respondents. Phelan et al.[11] on their studies also revealed that 29% of their respondents experienced menstruation in under two days.

Amenorrhea

Cases of secondary amenorrhea during the pandemic were also found in three studies. Medina-Perucha et al.[15] revealed that their respondents did not get menstruation for at least one cycle during the pandemic. This confirmed a study of Phelan et al.[11] which found their respondents did not experience their periods during the pandemic. Research conducted by Samo et al. also found that 16% of the respondents experienced amenorrhea during the pandemic.[13-20] Higher percentage were found in a study by Garcia de Leon et al.[21], which found that 23.7% of their respondents, specifically 13.1% of their under 40s respondent having fewer periods than before.

Dysmenorrhea

Dysmenorrhea is one of the most common findings during the pandemic. Six studies were found talking about dysmenorrhea. Medina-Perucha et al.[15] revealed an increase in menstrual pain out 12.6% of the respondents. A study conducted by Aolymat et al.[16] also found that during the pandemic, there was an increase in

severe dysmenorrhea by 13% compared to before the pandemic. Payne et al.[10] also revealed that the increase in stress and distress due to COVID has a relationship with more significant menstrual pain disorders. Samo et al.[13] also found that respondents to their study experienced dysmenorrhea. Higher percentage were found in these following latest studies: Garcia de Leon et al.[21] found that 44.3% of their respondents indicated more symptomatic on their periods, specifically 52.7% of their under 40s respondents. Phelan et al.[11] found that 49% of their respondents experienced higher dysmenorrhea than before the pandemic, and Maher et al.[12] also revealed that 59% of their research respondents experienced dysmenorrhea during the pandemic.

Premenstrual Syndrome

Cases of premenstrual syndrome were also found in some of these studies. Phelan et al.[11] revealed that 53% of respondents experienced premenstrual syndrome worse than before the pandemic. Payne et al.17 also revealed that increased stress and distress due to COVID were related to more frequent and severe menstrual symptoms. In other research, Maher et al.[12] revealed that 68% of respondents experienced more severe premenstrual syndrome symptoms than before the pandemic. This study was in line with the study conducted by Aolymat et al.[16] which also found an increase in the frequency of premenstrual syndrome

Polyhoamenorrhea

Polygoamenorrhea or shortened menstrual cycles have been found in four studies during COVID-19 pandemic. Samo et al.[13] revealed that 3% of the respondents in this study experienced a decrease in the length of the menstrual cycle. In another study, Medina-Perucha et al.[15] stated that 10% of respondents experienced shorter menstrual cycles. Higher percentage was found on Garcia de Leon et al's[21] study which stated that 15.7% of their respondents, specifically among 19% of them who were under 40s, had shorter periods than before. However, research conducted by Phelan et al.[11] and Nguyen et al.[14] showed no significant changes in the average cycle and duration of menstruation.

Oligomenorrhea

Oligomenorrhea had also been found in five studies. Samo et al.[13] revealed that 7.2% of their respondents experienced a cycle extension. Takmaz et al.[10] found that 12.9% of female medical personnel experienced menstrual cycle lengthening during the pandemic. In another research, Maher et al.[12] also revealed that 12.5% of their respondents experienced longer menstrual cycles. Garcia de Leon et al.[21] also found that 25.4% of their respondents, specifically 32.1% of them under 40s, indicated longer periods than before. However, less significant changes in mean cycle and menstrual length were found by Takmaz et al.[10] and Maher et al.[12], which remained at 28 days, but there was wider variability in minimum and maximum cycle length.

Menstrual abnormalities in COVID-19 pandemic

The difference in results related to abnormal menstruation can be attributed to the stress level experienced by the respondents. Eight of nine journals in this systematic review stated that higher levels of depression, anxiety, and stress were associated with menstrual abnormalities. Phelan et al.[11] stated that respondents with low mood, anxiety, and/or stress had a higher prevalence of changes in their menstrual cycle, worsening premenstrual symptoms, dysmenorrhea, and reduced libido. Garcia de Leon et al.[21] also stated that their analysis showed there were twice as many respondents who indicated changes in symptoms due to the pandemic control measures. In line with the research by Payne et al.[17], stress during the pandemic was associated with an increase in menstrual pain, the number and severity of premenstrual syndrome, as well as menstrual pain disorders. These menstrual abnormalities can also disturb a woman's quality of life.[18]

Broke down of the supply chains in the world, shutdown of retail stores, and mandated restrictions of movement during COVID-19 lockdowns had given negative affect of menstruators physical and mental health.[22,23]. The stress response is based on the hypothalamus-pituitary-adrenal (HPA) axis. Exposure to physical, social, and environmental stressors causes the secretion of various hormones and dysregulation of HPA axis activity.[19]. The HPA axis is activated during stress, which results in CRH secretion from the hypothalamus. CRH acts on the pituitary, facilitating the release of adrenocorticotropic hormone (ACTH), which interacts with the adrenal cortex and stimulates the release of cortisol. Chronic stress will produce an irregular HPA axis, as shown by glucocorticoids inhibiting the action of gonadotropin-releasing neurons (GnRH), gonadotrophs, and gonads. Excessive CRH levels can also cause inhibition of the hypothalamic-pituitary-gonadal (HPG) axis. Other obstacles that can occur include decreased pituitary response to GnRH, resulting in decreased secretion of luteinizing hormone (LH), giving direct inhibitory effects of glucocorticoids on sex hormone secretion, glucocorticoid-induced resistance to gonadal steroids in target tissues, and direct catecholaminergic inhibition of FSH, LH secretion, and prolactin.[10]

Contrasting to the stress levels, a study conducted by Nguyen et al.[14] states that the absence of this

relationship may be related to the sociodemographic of the respondents. This study was conducted on women with a college education in their 30s and in relationships. These criteria have been considered in several studies to be able to adapt well during the COVID-19 pandemic. This statement is supported by research by Kwak et al.[20] and Andiarna[23] which states that abnormal menstruation is commonly found in women with lower socioeconomic status and education. Significantly, seven out of eight studies concluded that there was a link between stress during the pandemic and abnormal menstruation. The highest cases were found in premenstrual syndrome and dysmenorrhea, and the lowest was found in menstrual cycle disorders (polygomenorrhea, oligomenorrhea, amenorrhoea).

Limitations of this study were in the choice of language, the difference in the use of questionnaires in each study, in which some studies did not include the results of their validity, and the lack of sources, which limited to open access study. These limitations reduced the diversity of information which could have been included in this systematic review.

CONCLUSION

There is a significant relationship between stress during the COVID-19 pandemic and the incidence of menstrual abnormalities. Future researchers are expected to be able to study further on the effect of stress during the COVID-19 pandemic on menstrual disorders.

DISCLOSURES

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None

Conflict of interest

There are no conflicts of interest in this study's content among all authors

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Author Contribution

All authors have contributed to all processes in this research, including preparation, data gathering and analysis, drafting and approval for publication of this manuscript.

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