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ORIGINAL RESEARCH

Self-Reported Menstrual Alterations During the COVID-19 Syndemic in Spain: A Cross-Sectional Study

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Introduction: Available evidence suggests that there might be an association between the stressors experienced during the COVID-19 syndemic and changes in menstrual patterns. The aim of this study was to assess self-reported menstrual alterations during the COVID-19 syndemic among women and people who menstruate aged 18–55 in Spain.

Materials and Methods: A cross-sectional online survey-based study was conducted (March–July 2021). Descriptive statistics were calculated and multivariate logistic regression models were constructed. This study was conducted as part of the "Equity and Menstrual Health in Spain" research project.

Results: Among participants (N=17,455), 39.4% reported menstrual alterations since the start of the syndemic. Participants self-reporting long COVID-19 presented higher odds of menstrual alterations (aOR: 1.34, 95% CI, 1.15-1.57). In participants with no history of COVID-19, the risk for self-reported menstrual alterations was significantly higher based on employment situation, among participants experiencing financial issues (eg, financial issues always/many times <12 months: aOR: 1.68, 95% CI, 1.48–1.90), poorer self-perceived health (eg, poor: aOR: 2.00, 95% CI, 1.31–3.07), and those diagnosed with polycystic ovary syndrome (aOR: 1.13, 95% CI, 1.02–1.26). Among participants with a self-reported COVID-19 diagnosis, factors that significantly increased the odds for menstrual alterations were experiencing financial strains (eg, financial issues always/many times <12 months: aOR: 1.53, 95% CI, 1.09–2.14), poorer self-perceived health (eg, poor: aOR: 3.09, 95% CI, 1.01–9.52). Overall, factors that decreased the odds of reporting menstrual alterations included age >25, being a carer, not having a gynecological condition and using hormonal contraception.

Discussion and conclusions: Findings suggest an impact of the COVID-19 syndemic on menstrual patterns. Social inequities in reporting menstrual alterations were identified. While the risk of reporting menstrual alterations was higher among participants with long COVID-19, evidence is not conclusive. Further research on menstrual health in the context of COVID-19 is needed, also to inform policy and practice.

Keywords: menstruation, COVID-19, long COVID-19, menstrual health, menstrual inequity, women's health

Plain Language Summary

There has been a lack of research on how the COVID-19 pandemic could have had an impact on menstrual cycles and menstruation. This study was conducted as part of a larger project on equity and menstrual health. It includes the responses of 17,455 women and people who menstruate (ie, non-binary and trans people who menstruate) to an online survey completed between March and July 2021 in Spain. We have found that 39.4% of our participants reported menstrual alterations since the start of COVID-19. The risk for

indicating menstrual alterations was higher in participants with a self-reported diagnosis of long COVID-19 (COVID-19 symptoms for more than 4 weeks), aged 25 or less, full/part-time workers and students, those on benefits, houseworkers or unpaid carers. Financial strains in the 12 months, a poorer self-perceived health and a gynecological diagnosis were other risk factors. Protective factors were being older than 25, caring for someone else (eg children), not having a gynecological diagnosis and using hormonal contraception. This study offers some findings on factors associated with self-reported menstrual alterations during COVID-19 in Spain. More research is needed to understand the changes that some women and people who menstruate have noticed on their menstrual cycles and menstruations in the context of the pandemic.

Introduction

There is virtually no evidence on how the COVID-19 syndemic – a term used to conceptualize ill-health in complex pandemics through understanding the intersection between socio-environmental and biological factors[1–4] -, COVID-19 infection and living with long-COVID-19 (or post COVID-19 condition based on a recent WHO definition)[5] can have an impact on menstrual health. The prevailing neglect of menstruation and the menstrual cycle as vital health signs and important tools for health promotion has also been apparent during the COVID-19 syndemic.[6,7] Menstrual inequities, partly resulting from this systemic neglect, and the actions needed to address them, are further being compromised, shadowed by the COVID-19 crisis.[6–9]

To our knowledge, only a handful of studies have attempted to address this knowledge gap. A single-centre retrospective study was conducted in China,[10] using both clinical and laboratory data, comparing menstrual patterns among women who were mildly and severely ill, and a control group in a total sample of 177 participants. This study found that 20% of women experienced decreased menstrual bleeding after confirmed COVID-19. However, there were no significant differences either in menstrual abundance changes between mildly and severely ill women, or in menstrual length changes before and after being diagnosed with COVID-19, although severely ill patients reported longer menstrual cycles. Besides, 18% women had prolonged cycles and 3% shortened cycles, and 7% showed menstrual cycle disorders. Compared to a control group, menstrual volume and menstrual cycle changes were increased in COVID-19 patients. Changes on the menstrual cycle and menstruation, which were more likely in women with multisystem dysfunction (ie, complications in, for instance, cardiovascular or digestive systems), were thought to return to normal after one or two cycles. Furthermore, the authors found that median concentrations of sex hormones were marginally higher, but not statistically significant, in both mildly and severely ill patients, compared to the control group.[10] The authors argued that the endocrine and ovarian systems were not seriously affected in women affected by COVID-19. Ovarian suppression (anovulation) was suspected given the high FSH and LH concentrations during early follicular phase.[10] This is coherent with previous studies reporting anovulation occurring in various acute diseases, to ensure an adequate functioning of essential organs diseases.[11] The study concluded that a direct effect of the SARS-COV-2 virus cannot be completely ruled out, given the transient alterations in hormone concentrations identified and women's reported menstrual changes. However, findings did not support that SARS-CoV-2 caused a substantial impairment on menstrual health.[10]

A cross-sectional study conducted in Jordan,[12] which included 200 women, indicated that menstrual problems had significantly decreased during COVID-19 curfew (10.5% vs 17.5% vs, p=0.016). Menstrual problems post-curfew did not differ from those at the pre-curfew stage. Besides, access to healthcare for menstrual problems was not statistically different between pre-curfew, during curfew and post-curfew, although telephone consultations were significantly heightened during curfew.[12] With curfew in Jordan only lasting for a few consecutive days, authors argued that population stress levels might not have been high enough to result in more menstrual alterations. These findings differ from those reported in an observational study, conducted in Turkey, showing an increase in menstrual disorders during the syndemic, compared to pre-syndemic (27.6% vs 12.1%, p=0.008). However, this study included only 58 participants thus data should be interpreted carefully.[13] Furthermore, in a recently published study conducted in Arizona (United States) 16% of participants with COVID-19 reported menstrual changes. Those reporting alterations were more likely to report more COVID-19 symptoms and higher self-rated illness severity scores. However, these findings should be interpreted with caution given the small sample size included.[14]

On the other hand, a study conducted in Turkey,[15] including data from 952 female healthcare professionals, reported that depression, anxiety and stress were significantly and positively associated with irregular menstruations (changes in

menstrual patterns in terms of frequency, regularity, duration or intensity and intermenstrual bleeding). In another Turkish study, researchers identified a relationship between anxiety scores, increased menstrual-related symptoms, shorter menstruations and use of menstrual pads.[16] However, increased self-reported stress levels did not seem to be more significantly associated with menstrual alterations during the syndemic (compared to pre-syndemic) in a retrospective cohort study using real-world data from a mobile app, including 214,426 cycles from 18,076 app users mostly in the United Kingdom and the United States.[17] In this study, the authors concluded that the COVID-19 had not significantly led to population-level changes in ovulation and menstrual patterns. Importantly, most included data were of women over 30 and with completed high education.[17] In fact, irregular menstruation has been previously found to be more prevalent among women of a lower socioeconomic and educational status,[18] which could be explained by a higher exposure to life stressors. Thus, socioeconomic variables should be considered when analyzing and interpreting menstrual health data.

Irregular menstrual patterns have been found to be related to a higher risk for developing cardiovascular disease, diabetes mellitus, chronic renal failure and infertility, premature menopause, breast and ovarian cancer in later life.[19–22] Besides, having menstrual health problems could also greatly compromise quality of life.[18,19] It is therefore urgent to conduct research on menstrual health in the context of the COVID-19 syndemic, also to address the prevailing androcentrism in science and sociopolitical structures.[23–26] The aim of this study was to assess self-reported menstrual alterations during the COVID-19 syndemic (2020–2021) among women and people who menstruate (PWM) aged 18–55 in Spain. Data presented in this publication are part of the "Equity and Menstrual Health in Spain" study, a larger mixed-methods project that aimed at assessing menstrual health and menstrual inequities in Spain.

Materials and Methods

This is a cross-sectional study including women and PWM aged 18–55 living in Spain (N=22,823). Data were collected through an online survey between 24th of March and 8th of July 2021, using the Lime Survey platform (https://www.limesurvey.org). The online survey included questions on menstrual health and menstrual inequity and was developed by the research team throughout several meetings and based on previous evidence and guidelines to devise non-validated questionnaires.[27] The survey was piloted and available in Spanish. Only statistical analyses referring to the COVID-19 syndemic and the perceived impacts of COVID-19 on menstrual health were included in this publication. Pregnant and breastfeeding participants who reported not menstruating at the time of data collection were excluded from the analyses. The current publication includes data from 17,455 women and PWM.

Participants and Sample Size

Main inclusion criteria were: 1) to menstruate, 3) be between 18 and 55 years old, and 3) live in Spain at the time of data collection. Having entered menopause or not menstruating for over 12 consecutive months was a main exclusion criteria. Sample size power calculations were done for the overall quantitative study for the "Equity and Menstrual Health in Spain" project. Given the lack of research on menstrual inequity, we used a menstrual hygiene management variable from previous studies as a main variable for sample size calculations. Maximum indetermination of the main variable (proportion of 50%) was assumed. These assumptions were in order to obtain a precision of 2.5% in the confidence intervals. These estimates have been calculated assuming an alfa risk of 5%. PASS software was used for the sample size calculations [PASS 15 Power Analysis and Sample Size Software (2017). NCSS, LLC. Kaysville, Utah, USA]. A minimum of 1,535 participants were required.

Sampling and Recruitment

Sampling was non-probabilistic and purposive. Participants were recruited through social media (Instagram, Twitter and WhatsApp) and relevant key persons and organizations, such as sexual and reproductive health centers, primary healthcare centers, non-governmental organizations, and other local organizations. Snowball sampling techniques were also applied. Special attention was paid to recruiting women and PWM who had limited access to social media, people living in socioeconomically deprived areas, participants from the Roma community and migrant populations. This was done through collecting data in person in a foodbank, a service for sex workers and sexual and reproductive health centers.

Data Analyses

Descriptive statistics were performed for each variable. Age was analyzed as mean (SD) and categorized. Categorical variables were described as percentages. Chi-square tests were used to assess differences between socioeconomic variables according to menstrual alterations, self-reported health, gynecological diagnosis, and use of hormonal contraception. Multivariate logistic regression models were constructed to assess the relationship between self-reported menstrual alterations (main outcome variable), and sociodemographics, self-perceived health, gynecological diagnosis, use of hormonal contraception, and diagnosed/suspected COVID-19 and long COVID-19. Models were also generated to compare odds of self-reported menstrual alterations among participants with no history of COVID-19 and participants with a self-reported diagnosis of COVID-19. We conducted a sensibility analysis, excluding participants with existing gynecological conditions (endometriosis/adenomyosis, myomas and ovary polycystic syndrome) and using hormonal contraceptives, to assess potential confounding in the relationship between menstrual alterations, sociodemographic characteristics and self-reported health. The level of statistical significance was set at 0.05 and all tests were 2-tailed. Analyses were conducted using SPSS 25.0 (SPSS Inc., Armonk, NY: IBM Corp), and Stata/MP 17.0 (StataCorp LLC, TX).

Results

Participant Characteristics

Participants were 17,455 women and PWM between 18 and 55 years old *(M=32.3, SD=8.9)*. Most identified their gender as women (96.6%), followed by non-binary/other (3.4%); 0.9% identified as trans. Almost all were born in Spain (93.5%) and held Spanish nationality (95.9%). Over half were working full- or part-time (62.9%) and had completed university degrees (68.2%). Carers (eg of minors) accounted for 22.4% of the sample. Almost half reported financial problems in the 12 months preceding the study (45.0%). Self-reported health was most commonly perceived as good (45.8%), followed by very good (37.5%). Besides, 29.9% reported having a diagnosis of endometriosis/adenomyosis, myoma, or polycystic ovarian syndrome (PCOS). Some participants were using hormonal contraception at the time of data collection (16.7%); 49.8% had previously used them (see Table 1).

A total of 1,959 (12.6%) participants reported having been diagnosed with COVID-19; 546 (27.9%) reported long COVID-19. Also, 1,231 (7.9%) reported having had COVID-19-compatible symptoms and, of these, 202 (16.4%) indicated a possible long COVID-19. Among participants reporting menstrual alterations, 28.8% had tried to access healthcare services to seek professional assistance; 5.1% could not access services as no appointments were available at the time of consultation. Interestingly, the use of private (9.5%) and public healthcare (11.5%) was similar. Furthermore, 23.1% participants reported having had issues accessing menstrual products during the COVID-19 syndemic (see Table 1).

Main Findings

Menstrual alterations were reported in 39.4% of participants, since the start of the COVID-19 syndemic. Changes reported were increased menstrual pain (12.6%), longer menstrual cycles (12.5%), shorter menstrual cycles (10.0%), more abundant bleeding (7.2%), missing menstruation at least in one cycle (6.8%), increased menstruating days (6.0%), decreased menstruating days (5.1%), less abundant bleeding (5.0%), and decreased menstrual pain (2.9%) (see Table 1). There were significant differences among participant groups in the reports of menstrual alterations during the COVID-19 syndemic (see Table 2).

Multivariate logistic regression analyses showed associations between self-reported menstrual alterations and several variables among participants with no history of COVID-19 and participants who reported a diagnosis of COVID-19 (see Table 3). The risk of reporting menstrual alterations was significantly increased in participants with suspected COVID-19 (aOR: 1.15, 95% CI, 1.02–1.30), but it was not in participants with diagnosed COVID-19. When including long COVID-19 in the analyses, odds were only significantly increased among participants with suspected/diagnosed long-COVID-19 (aOR: 1.34, 95% CI, 1.15–1.57) (Table 3).

Table 1 Sociodemographic Characteristics, Self-Perceived Health, Menstrual Alterations, Gynecological Diagnosis, Use of Hormonal Contraception, Diagnosed/Suspected COVID-19 and Long-COVID-19 (N=17,455)

Variable	N (%)
Age	M (SD)= 32.3 (8.9)
18–25	4932 (28.3%)
26–35	6333 (36.3%)
36–45	4632 (26.5%)
46–55	1558 (8.9%)
Gender	
Women	16,861 (96.6%)
Non-binary/other	594 (3.4%)
Trans	
Yes	163 (0.9%)
I do not know	130 (0.7%)
No	17,162 (98.3%)
Country of birth	
Spain	16,040 (93.5%)
Other	1121 (6.5%)
Administrative situation	
Spanish nationality	16,692 (95.9%)
Permanent residency	538 (3.1%)
Temporal residency	145 (0.8%)
No permit/in process	35 (0.2%)
Employment situation	
Working full-time/part-time	10,975 (62.9%)
Self-employed	1464 (6.1%)
Studying full-time/part-time	5176 (29.7%)
On benefits (unemployment, COVID-19 benefits, retirement and other benefits)	1562 (8.9%)
Unpaid carer/houseworker	700 (4.0%)
Completed education	
Primary education	168 (1.0%)
Secondary education	5379 (30.9%)
University education	11,886 (68.2%)
Carer	
No	13,468 (77.6%)
Yes	3881 (22.4%)
Financial problems <12 months	
Always/Many times	2148 (12.6%)
Some/A few times	5516 (32.4%)
Never	9384 (55.0%)
Self-reported health	
Excellent	1114 (6.4%)
Very good	6528 (37.5%)
Good	7975 (45.8%)
Fair	1629 (9.4%)
Poor	174 (1.0%)

(*Continued*)

Table 1 (Continued).

Variable	N (%)
Self-reported menstrual alterations	
Any	6871 (39.4%)
Increased menstrual pain	2203 (12.6%)
Decreased menstrual pain	499 (2.9%)
Shorter menstrual cycles	1754 (10.0%)
Longer menstrual cycles	2183 (12.5%)
No menstruation (>1 menstrual cycle)	1179 (6.8%)
More abundant bleeding	1252 (7.2%)
Less abundant bleeding	877 (5.0%)
Increased menstruating days	1039 (6.0%)
Decreased menstruating days	882 (5.1%)
Gynecological diagnosis	
Endometriosis/adenomyosis	996 (5.7%)
Myomas	1159 (6.6%)
Polycystic ovarian syndrome	3064 (17.6%)
Other diagnoses	10,233 (58.6%)
No diagnosis	5172 (29.6%)
Use of hormonal contraception	
Current use	2908 (16.7%)
Previous use	8686 (49.8%)
Never	5833 (33.5%)
Self-reported diagnosed/suspected COVID-19	
Diagnosed COVID-19	1959 (12.6%)
Suspected COVID-19	1231 (7.9%)
No COVID-19	12,310 (79.4%)
Access to healthcare services during the syndemic for menstrual alterations (N=6871)	
No access	4892 (71.2%)
No appointments available	348 (5.1%)
Yes, accessed private healthcare	653 (9.5%)
Yes, accessed public healthcare	789 (11.5%)
Yes, access both private and public healthcare	184 (2.7%)
Issues accessing menstrual products during the COVID-19 syndemic	
Always/many times	450 (2.6%)
Some/a few times	3532 (20.5%)
Never	13,257 (76.9%)

Participants with No History of COVID-19

Among women and PWM with no history of COVID-19, some employment situations significantly heightened the odds of self-reported menstrual alterations. Risk of menstrual alterations was higher among participants working full/part-time (aOR: 1.14, 95% CI, 1.02–1.28), full and part-time students (aOR: 1.19, 95% CI, 1.06–1.33), those receiving unemployment, COVID-19 or other state benefits (aOR: 1.18, 95% CI, 1.01–1.38), and unpaid carers and houseworkers (aOR: 1.29, 95% CI, 1.05–1.58). Although not statistically significant, participants with completed university education had higher odds of reporting menstrual alterations (aOR: 1.46, 95% CI, 0.97–2.18). Having had financial problems in the 12 months preceding the study was another factor significantly associated with reporting menstrual alterations [aOR (always/many times): 1.68, 95% CI, 1.48–1.90]. Odds for self-reported menstrual alterations increased as self-perceived health worsened

Table 2 Self-Reported Menstrual Alterations by Sociodemographics, Self-Reported Health, Gynecological Diagnosis, Use of Hormonal Contraception, Confirmed/Suspected COVID-19 and Long-COVID-19 and Issues Accessing Menstrual Products During the COVID-19 Syndemic (N=17,455)

	No Menstrual Alterations (N= 10,584) N (%)	Menstrual Alterations (N= 6871) N (%)	P-value*
Age			
18–25	2877 (58.3%)	2055 (41.7%)	<0.001
26–35	3776 (59.6%)	2557 (40.4%)	
36–45	2940 (63.5%)	1692 (36.5%)	
46–55	991 (63.6%)	567 (36.4%)	
Gender			
Women	10,268 (60.9%)	6593 (39.1%)	<0.001
Non-binary/other	316 (53.2%)	278 (46.8%)	
Trans			
Yes	83 (50.9%)	80 (49.1%)	0.004
I do not know	67 (51.5%)	63 (48.5%)	
No	10,434 (60.8%)	6728 (39.2%)	
Country of birth			
Spain	9764 (60.9%)	6276 (39.1%)	<0.001
Other	618 (55.1%)	503 (44.9%)	
Administrative situation			
Spanish nationality	10,164 (60.9%)	6528 (39.1%)	0.001
Other administrative situation	394 (54.9%)	324 (45.1%)	
Employment situation			
Working full-time/part-time	6772 (61.7%)	4203 (38.3%)	<0.001
Self-employed	867 (59.2%)	597 (40.8%)	0.247
Studying full-time/part-time	2995 (57.9%)	2181 (42.1%)	<0.001
On benefits (unemployment, COVID-19 benefits, retirement and other benefits)	894 (57.2%)	668 (42.8%)	0.004
Unpaid carer/houseworker	388 (55.4%)	312 (44.6%)	0.004
Completed education			
Primary education	107 (63.7%)	61 (36.3%)	0.119
Secondary education	3204 (59.6%)	2175 (40.4%)	
University education	7261 (61.1%)	4625 (38.9%)	
Carer			
Yes	2517 (64.9%)	1364 (35.1%)	<0.001
No	8017 (59.5%)	5451 (40.5%)	
Financial problems <12 months			
Never	6128 (65.3%)	3256 (34.7%)	<0.001
Always/Many times	3125 (56.7%)	2391 (43.3%)	
Some/A few times	1072 (49.9%)	1076 (50.1%)	
Self-reported health			
Excellent	757 (68.0%)	357 (32.0%)	<0.001
Very good	4200 (64.3%)	2328 (35.7%)	
Good	4730 (59.3%)	3245 (40.7%)	
Fair	799 (49.0%)	830 (51.0%)	
Poor	80 (46.0%)	94 (54.0%)	

(*Continued*)

Table 2 (Continued).

	No Menstrual Alterations (N= 10,584) N (%)	Menstrual Alterations (N= 6871) N (%)	P-value*
Gynecological diagnosis			
Endometriosis/adenomyosis	559 (56.1%)	437 (43.9%)	0.003
Myomas	684 (59.0%)	475 (41.0%)	0.243
Ovary polycystic syndrome	1742 (56.9%)	1322 (43.1%)	<0.001
No diagnosis	3361 (65.0%)	1811 (35.0%)	<0.001
Use of hormonal contraception			
Never	3424 (58.7%)	2409 (41.3%)	<0.001
Previous use	5104 (58.8%)	3579 (41.2%)	
Current use	2036 (70.0%)	872 (30.0%)	
Confirmed/suspected COVID-19			
COVID-19 diagnosis	1200 (61.3%)	759 (38.7%)	<0.001
Suspected COVID-19	687 (55.8%)	544 (44.2%)	
No COVID-19	7592 (61.7%)	4718 (38.3%)	
Confirmed/suspected long COVID-19			
Long-COVID-19 diagnosis	299 (54.8%)	247 (45.2%)	<0.001
Suspected long-COVID-19	101 (50.0%)	101 (50.0%)	
COVID-19 diagnosis (no long COVID-19)	1408 (61.2%)	891 (38.8%)	
Issues accessing menstrual products during the COVID-19 syndemic			
Always/many times	210 (46.7%)	240 (53.3%)	<0.001
Some/A few times	1789 (50.7%)	1743 (49.3%)	
Never	8464 (63.8%)	4793 (36.2%)	

Notes: *Chi-square test.

[aOR (poor): 2.00, 95% CI, 1.31–3.07]. Being diagnosed with myomas (aOR: 1.17, 95% CI, 1.00–1.37) or PCOS (aOR: 1.13, 95% CI, 1.02–1.26) were also associated with higher odds of menstrual alteration reports, although the relationship with myomas was only almost significant (Table 3).

In turn, factors associated with decreased odds of self-reporting menstrual alterations among participants with no history of COVID-19 were: being over 25 years old [(aOR (25–36): 0.84, 95% CI, 0.75–0.95); (aOR: 0.72, 95% CI, 0.63–0.84); (aOR: 0.78, 95% CI, 0.65–0.94)], identifying as a carer (aOR: 0.83, 95% CI, 0.74–0.93), not having a gynecological diagnosis (aOR: 0.83, 95% CI, 0.75–0.90) and currently using hormonal contraception (aOR: 0.55, 95% CI, 0.48–0.62) (Table 3).

Participants with a Self-Reported COVID-19 Diagnosis

Among participants with a reported COVID-19 diagnosis, risk for self-reported menstrual alterations was increased based on having financial problems (aOR: 1.29, 95% CI, 1.03–1.61), worse self-perceived health (aOR: 3.09, 95% CI, 1.01–9.57), and having a diagnosis of endometriosis/adenomyosis (aOR: 1.51, 95% CI, 0.98–2.32), although the latter association was not statistically significant (Table 3).

Age and employment situation variables were not significantly associated with decreased odds of menstrual alterations self-reports in participants with diagnosed COVID-19. However, age between 25–36 was an almost statistically significant risk factor (aOR: 0.91, 95% CI, 0.66–1.25). The same was found for being a carer, although a reduction in odds ratios were identified, this variable was not statistically significant (aOR: 0.76, 95% CI, 0.57–1.03). Not being diagnosed with the gynecological conditions included in the analyses (aOR: 0.63, 95% CI, 0.49–0.79) and currently using hormonal contraception (aOR: 0.40, 95% CI, 0.29–0.54) were other variables that reduced the odds of reporting menstrual alterations among participants with a COVID-19 diagnosis (Table 3).

Table 3 Associations Between Self-Reported Menstrual Alterations and Sociodemographic Characteristics, Self-Reported Health, Gynecological Diagnosis, and Use of Hormonal Contraception, Among All Participants, Participants Reporting No History of COVID-19 and Participants Reporting a COVID-19 Diagnosis (N=14,773)

	All Participants (N=14,773)		No History of COVID-19 (N=11,734)		Self-Reported COVID-19 Diagnosis (N=1865)	
	aOR (95% CI)	p value	aOR (95% CI)	p value	aOR (95% CI)	p value
Age						
18–25	1.00		1.00		1.00	
26–35	0.85 (0.77–0.95)	0.004	0.84 (0.75–0.95)	0.005	0.91 (0.66–1.25)	0.055
36–45	0.74 (0.65–0.84)	<0.001	0.72 (0.63–0.84)	<0.001	0.75 (0.51–1.10)	0.139
46–55	0.80 (0.68–0.95)	0.012	0.78 (0.65–0.94)	0.010	0.90 (0.55–1.47)	0.675
Country of birth						
Spain	1.00		1.00		1.00	
Other	1.15 (0.97–1.37)	0.109	1.01 (0.79–1.29)	0.939	1.26 (0.78–2.04)	0.346
Administrative situation						
Spanish nationality	1.00		1.00		1.00	
Other administrative situation	1.07 (0.86–1.32)	0.542	1.07 (0.86–1.32)	0.542	0.99 (0.54–1.80)	0.963
Employment situation						
Working full-time/part-time	1.11 (1.01–1.23)	0.037	1.14 (1.02–1.28)	0.022	1.03 (0.76–1.39)	0.857
Self-employed	1.11 (0.96–1.28)	0.154	1.12 (0.95–1.32)	0.165	1.31 (0.85–2.01)	0.225
Studying full-time/part-time	1.13 (1.02–1.25)	0.019	1.19 (1.06–1.33)	0.003	1.04 (0.76–1.40)	0.824
On benefits (unemployment, COVID-19 benefits, retirement and other benefits)	1.12 (0.97–1.28)	0.124	1.18 (1.01–1.38)	0.039	0.83 (0.53–1.28)	0.391
Unpaid carer/houseworker	1.19 (0.99–1.42)	0.064	1.29 (1.05–1.58)	0.015	0.67 (0.38–1.20)	0.177
Completed education						
Primary education	1.00		1.00		1.00	
Secondary education	1.25 (0.86–1.82)	0.250	1.30 (0.87–1.96)	0.207	0.47 (0.14–1.54)	0.212
University education	1.34 (0.92–1.96)	0.124	1.46 (0.97–2.18)	0.070	0.43 (0.13–1.41)	0.163
Carer						
No	1.00		1.00		1.00	
Yes	0.82 (0.75–0.91)	<0.001	0.83 (0.74–0.93)	0.001	0.76 (0.57–1.03)	0.077
Financial problems <12 months						
Never	1.00		1.00		1.00	
Some/A few times	1.31 (1.21–1.42)	<0.001	1.33 (1.22–1.45)	<0.001	1.29 (1.03–1.61)	0.014
Always/Many times	1.67 (1.49–1.86)	<0.001	1.68 (1.48–1.90)	<0.001	1.53 (1.09–2.14)	0.016

(Continued)

Table 3 (Continued).

	All Participants (N=14,773)		No History of COVID-19 (N=11,734)		Self-Reported COVID-19 Diagnosis (N=1865)	
	aOR (95% CI)	p value	aOR (95% CI)	p value	aOR (95% CI)	p value
Self-perceived health						
Excellent	1.00		1.00		1.00	
Very good	1.15 (0.99–1.33)	0.061	1.11 (0.94–1.30)	0.214	1.48 (0.94–2.33)	0.094
Good	1.41 (1.22–1.63)	<0.001	1.35 (1.15–1.58)	<0.001	1.64 (1.04–2.6)	0.033
Fair	2.00 (1.68–2.40)	<0.001	1.88 (1.54–2.30)	<0.001	2.75 (1.6–4.72)	<0.001
Poor	2.17 (1.50–3.14)	<0.001	2.00 (1.31–3.07)	0.001	3.09 (1.01–9.52)	0.049
Diagnosis						
Endometriosis/adenomyosis	1.12 (0.96–1.30)	0.146	1.05 (0.89–1.24)	0.555	1.51 (0.98–2.32)	0.060
Myomas	1.17 (1.01–1.35)	0.033	1.17 (1.00–1.37)	0.055	1.03 (0.68–1.56)	0.906
Polycystic ovary syndrome	1.16 (1.06–1.28)	0.002	1.13 (1.02–1.26)	0.020	1.01 (0.77–1.32)	0.964
No diagnosis	0.80 (0.74–0.87)	<0.001	0.83 (0.75–0.90)	<0.001	0.63 (0.49–0.79)	<0.001
Use of hormonal contraception						
Never	1.00		1.00		1.00	
Previous use	0.99 (0.91–1.07)	0.723	1.01 (0.92–1.10)	0.897	0.93 (0.73–1.17)	0.517
Current use	0.52 (0.46–0.58)	<0.001	0.55 (0.48–0.62)	<0.001	0.40 (0.29–0.54)	<0.001
COVID-19						
No COVID-19	1.00					
COVID-19	1.07 (0.98–1.16)	0.118				
COVID-19						
No COVID-19	1.00					
Suspected COVID-19	1.15 (1.02–1.30)	0.026				
COVID-19 Diagnosis	1.02 (0.92–1.13)	0.723				
COVID-19						
No COVID-19	1.00					
COVID-19 (no Long COVID-19)	0.99 (0.91–1.09)	0.911				
Long COVID-19	1.34 (1.15–1.57)	<0.001				

Abbreviation: aOR, adjusted odds ratios.

Sensitivity analyses were conducted excluding participants with gynecological conditions and those taking hormonal contraception. Overall, there were minimal variations to odd ratios and their directionality. However, some variables ceased to be statistically significant risk (eg, employment situation) or protective (eg, age between 46 and 55 in participants with no history of COVID-19) factors in sensitivity analyses. This was due to the loss in statistical power. Therefore, there were no significant differences in the findings from the sensitivity analyses, compared to the findings reported in Table 3 (see Supplementary Table).

Discussion

Over one third of participants reported having experienced menstrual changes during the COVID-19 syndemic, a higher prevalence compared to the one reported in studies in other countries during the syndemic (10.5–12.1%).[12,13] Overall, our findings suggest that experiencing menstrual alterations is associated with long COVID-19, being younger than 25, being a student or worker (full- or part-time), receiving state benefits or being an unpaid carer or houseworker, and having financial problems. Also, having a poorer self-perceived health and a gynecological diagnosis such as PCOS. On the other hand, caring for someone else and using hormonal contraception were protective factors for reporting menstrual alterations. Furthermore, 23.1% women and PWM had issues accessing menstrual products during the syndemic. Among participants experiencing menstrual alterations, 5.1% could not access healthcare services due to appointments were not available; 11.5% accessed public healthcare services and 9.5% had access to private healthcare.

In order to interpret these data, it is important to refer to the complex intersection between socio-environmental and biological factors to understand ill-health.[28–30] The link between social determinants of health, social inequities and health outcomes is well-established.[31–35] Recent studies have highlighted how social determinants of health have an impact on COVID-19 incidence and outcomes,[36,37] as well as on other health outcomes.[38–40] Besides, menstrual problems have already been found more prevalent during complex social crises (eg, wars, earthquakes),[41–44] including recent evidence that identifies COVID-19 syndemic stress as a significant predictor of menstrual irregularities.[15] A general plausible explanation may be related to the social and environmental context and dysregulations of the hypothalamic-pituitary-gonadal (HPA) axis.[45–48]

One of the findings from our research is that being aged below 25 meant a higher risk for reporting menstrual alterations. This is consistent with previous studies indicating worse mental health outcomes among younger adults in Spain[38] and in other countries[49] during the syndemic. Our results further support that young adults may have been more impacted by the stressors of the COVID-19 crisis, although further investigations are needed to determine the factors associated with this impact. Besides, the close relationship between mental health and menstrual patterns has also been investigated in the past,[21,48,50–54] suggesting a link between emotional wellbeing and menstrual health.

Employment situation was also an important factor for reporting menstrual alterations. We can hypothesize that the relationship between employment situation and menstrual alterations is two-fold. On one hand, actively working and studying during the syndemic could have led to multiple stressors of worsening employment and studying conditions (eg, teleworking, lack of online studying resources).[55] On the other hand, being on benefits (eg, unemployment or COVID-19 benefits) could explain higher self-reported menstrual alterations, based on experiencing stressors related to the loss of employment and adverse job-seeking prospects throughout the COVID-19 crisis. In fact, previous evidence already indicates that unemployment and low-quality employment have similar detrimental effects on mental wellbeing.[56] In addition, women's participation in the labor force may decrease their burden of care, which could contribute to improving their health.[57] For unpaid carers and houseworkers, reporting menstrual alterations could be explained by the reduction (or disappearance) of support networks, especially during lockdown periods, and the resulting worsening of living conditions and mental health.[58–61] However, we also found that being a carer was a protective factor for reporting menstrual alterations. Despite this may seem contradictory, we assume that most women and PWM who identified as carers had a source of employment or were studying. In such cases, and as we have already reported, a determining risk factor for reporting menstrual alterations might actually be employment status rather than caring itself. This could be explained by the potential good housing conditions and reduced financial strains of our sample. Apart from this, a higher socioeconomic status could mean having a more extensive care network and being able to externalize caring tasks when possible during COVID-19 (eg, hire a sitter or carer). In fact, being an informal caregiver has already been found to be

a protective factor for depression among women in Spain during COVID-19.[37] Besides, financial strains were systematically associated with reporting menstrual alterations in our study. In fact, experiencing financial issues has already been linked to poorer self-perceived health and psychological wellbeing among European workers.[62] Southern European countries like Spain are the ones with the highest prevalence of financial strains.[62] This again suggests the associations between experiencing life stressors and poorer menstrual health, as previously studies have indicated.[18]

On the other hand, this may be one of the first studies reporting an association between self-perceived health and menstrual patterns. We found that women and PWM who rated their health as worse were more likely to report menstrual changes in the context of COVID-19, even if we do not have data on health conditions other than some chronic gynecological conditions (ie, endometriosis/adenomyosis, myomas and PCOS). This association could not only be related to morbidity but mental health and wellbeing, given that self-perceived health is a good indicator of socio-economic class, physical and mental health status.[63] As we might expect, participants with previous gynecological conditions that commonly include menstrual changes (eg, PCOS) were more likely to report menstrual changes.[64,65]

Considering menstrual inequities in the context of social and health crises is also imperative.[6–9] As our findings showed, more than 2 in 10 women and PWM had experienced barriers to finding menstrual products during the syndemic. We believe that this may be related to mobility restrictions during lockdown periods and in more rural areas. Besides, 5.1% of participants reporting menstrual alterations could not access healthcare assistance, likely due to the healthcare system' saturation.[66] Interestingly, participants accessed public and private healthcare similarly. This may indicate that the overload in public healthcare services led women and PWM to access private healthcare. It also means that participants could afford private healthcare, which is consistent with the high level of education and employment rates among study participants. Having private health insurance, which has become increasingly common in Spain particularly after the economic crisis in 2008, reduces the use of public services.[67] However, not all women and PWM can pay for private healthcare. Therefore, public health systems need to be strengthened, not only to sustain ill-health in a syndemic but also to attend health-related consultations that might otherwise be left unattended, especially among more vulnerable populations. To attain this, we argue that social inequities and gender-based frameworks are essential for effective actions in research, policy and practice.

Lastly, even if there were differences between participants with no history of COVID-19 and those with self-reported COVID-19 diagnosis, factors that increased the odds of reporting menstrual alterations were similar in both groups. Still, participants with a reported diagnosis of long COVID-19 seemed more likely to report menstrual alterations. This may suggest that factors potentially contributing to menstrual alterations among women and PWM with COVID-19, and particularly long COVID-19, need to be further explored for evidence to be more conclusive.[10,12–17] While this article did not focus on the potential impact of COVID-19 vaccination on menstrual patterns, there are reports of women experiencing menstrual changes post-vaccine.[7] However, menstrual alterations have not yet been reported and listed as plausible COVID-19 vaccine side effects, and the menstrual cycle and menstruation have not generally been considered in clinical trials for COVID-19 vaccine development and other COVID-19 research. In the meantime, women and PWM should be encouraged to share menstrual changes with their health professionals, while the latter should not dismiss these reports. Further research should urgently consider the menstrual cycle and menstruation in the context of the COVID-19 syndemic,[7] to inform clinical practice and policymaking.

Limitations

Several limitations need to be acknowledged when interpreting the findings from this study. First, neither the sample included is representative of the Spanish population nor does the study design allow us to establish causality. Second, data are self-reported, including the diagnosis of COVID-19, long COVID-19 and gynecological conditions. Besides, other comorbidities including mental health were not collected and included in the analyses. Third, we do not know the time, duration and severity of the reported menstrual alterations, or whether they were also experienced before COVID-19. Fourth, we did not collect data on health habits, and use of medication other than hormonal contraception. Fifth, we used the term and definition of "long COVID-19" available at the time of data collection, although we are aware that this definition has changed over time. This may differ from current definitions and terminologies of long COVID-19. Furthermore, we do not know how long COVID-19 persisted and which were the symptoms experienced. Last, despite the team's efforts to recruit women and PWM

with lower educational attainment and a lower socioeconomic status, the sample underrepresents these groups of women and PWM. Despite all limitations, we strongly believe that this piece of research can be a valuable contribution to the scarce evidence on menstrual health and menstrual inequity in the context of COVID-19.

Conclusions

While evidence needs to be interpreted with caution, findings from this study indicate that stressors during the COVID-19 syndemic may have had an impact on menstrual patterns. Despite women and PWM with a reported diagnosis of long COVID-19 appeared to be more at risk of reporting menstrual alterations, evidence is not conclusive. Social inequities in experiencing menstrual alterations need to be considered, given the differential impact of the COVID-19 syndemic on menstrual patterns by sociodemographic characteristics. Future mixed-methods research, is required to further investigate the potential links between menstrual health and COVID-19, as well as menstrual inequities in the context of social and health crises such as the COVID-19 syndemic. Research should aim to be transformative and inform both policy and practice.

Abbreviation

PWM, people who menstruate.

Data Sharing Statement

The datasets generated and analyzed during the current study are not publicly available to maintain participants' anonymity and confidentiality, but are available from the corresponding author on reasonable request.

Ethics Approval and Informed Consent

Ethical approval was obtained from IDIAPJGol Ethical Committee on 21st November 2020, Ref 19/178-P. All activities included in the study were carried out according to existing guidance in ethics as indicated in the Universal Declaration on Bioethics and Human Rights adopted by UNESCO (19/10/2005); the Council of Europe Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine (1997) and its additional protocol on biomedical research (2005); the Helsinki Declaration (2013) and relevant EU laws (European Parliament and Council Directive 2001/20/EC); the Spanish Law on Biomedical Research (14/2007) and the LOPD (Spanish Law on Personal Data Protection) (3/2018). Participant information sheets were available for all participants. Written consent was requested prior to participation. All data have been stored and managed safely to ensure participants' confidentiality and anonymity.

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Author Contributions

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Disclosure

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