Does a Menstrual State and Hormonal Contraception Use Determine Exercise Participation? A Study of 8060 Exercising Women

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Does a menstrual state and hormonal contraception use determine exercise participation? A study of 8060 exercising women

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Keywords: Exercising women; Period, Athlete; Menstrual dysfunction; Menstrual Disruption

Abstract:

Background: Menstrual states and hormonal contraceptive (HC) use may affect athletic training and performance. Prevalence of different menstrual states, menstrual dysfunctions (MD) and HC use is not well established in the exercising population. This study aims to describe this, as well as identify the impact that menstrual states may have on training and performance.

Methods: 8,060 pre-menopausal women, aged 18 or over, from 6 territories were recruited through STRAVA™ exercise app. An online survey was completed to understand current menstrual states, hormonal contraceptive use, current exercise volume and perceived influence of the menstrual cycle on training and competition.

Results: The most prevalent menstrual state was eumenorrhea (42.1%) and HC was used in 39.7% of participants. The occurrence of oligomenorrhea (14.5%), non-hormonal IUD (NonH IUD) (6.0%), amenorrhea (4.4%) and polymenorrhea (1.1%) was comparatively lower. HC users were significantly less likely to miss/change training compared with eumenorrhea (*P<0.00])* or polymenorrhea (*P=0.035)* cycles. HC users were significantly less likely to miss a race/event/competition than those with a eumenorrheic cycle (*P*<0.001) or amenorrhea (*P*=0.021). Those with polymenorrhea were significantly more likely to miss a race/event/competition than those with a eumenorrheic cycle (*P*=0.032,), oligomenorrhea (*P*<0.001), HC users (*P*<0.001) or NonH IUD users (*P*=0.017). Ovarian cysts (11.3%) and polycystic ovarian syndrome (7.9%) were the most reported forms of MD.

Conclusions: Most participants were eumenorrheic or using hormonal contraception. Having polymenorrhoea or amenorrhoea was associated with an increased likelihood of negative outcomes on exercise participation. Those using HC were less likely to miss/change training.

Keywords: Exercising women; Sport, Period, Athlete; Menstrual dysfunction; Menstrual Disruption

1. Introduction

A eumenorrheic, 'regularly menstruating', menstrual cycle (MC) is defined as a MC lasting 21-35 days, or 10-17 cycles within the last 12 months.[1] Cyclical fluctuations of endogenous oestrogen and progesterone are identifiable throughout a eumenorrheic cycle and characterised by the early follicular phase (onset of menses and low concentrations of both oestrogen and progesterone), mid-follicular phase (high oestrogen and low progesterone) and mid-luteal phase (high oestrogen and progesterone).[2-4] However, not all females experience a eumenorrheic cycle. The rhythmicity of these hormonal fluctuations can be influenced by a number of internal and external factors including medical causes such as endometriosis and polycystic ovary syndrome to name a few, as well as nutrition, psychological stress, training load, body weight and hormonal contraceptive (HC) use.[5-8]

Within the exercising female population, menstrual disturbances e.g., luteal phase deficiency and anovulation are well acknowledged.[9,10] Menstrual disturbances such as amenorrhea (90 or more days without menses), [11] oligomenorrhea (MC lasting 35-90 days),[11] and polymenorrhea (MC less than 21 days)[1] are more prevalent in the exercising female population than the general female population,[1] however, the prevalence of these menstrual states is not well documented. These disturbances are believed to be in part due to a physiological protective mechanism to conserve energy, where energy availability fails to meet basic physiological needs once energy has been expended,[10] however, the cause likely involves multiple interrelated stressors.[12]. In states of low energy availability, energy is prioritised to critical processes to maintain optimal homeostasis for survival, this results in a suppression of energy available for normal reproductive functioning.[10,13] Not all exercising females experience overt MDs such as amenorrhea and oligomenorrhea. Approximately 50% of exercising women may experience subtle and undetected disturbances in their MC, including luteal phase defects and anovulation.[14] Subtle menstrual disturbances often go unrecognised due to the existence of a regular bleed,[14] in addition, both dysfunctions and disturbances can be masked by the use of HC's.[15]

For many, the primary purpose of HC use is to prevent pregnancy,[16] however in exercising women the motivation to use HC's may be broader. Here HC's may be used to manipulate the natural MC to avoid the inconvenience of menses, treating dysmenorrhea, and avoiding the negative impacts of the MC on training, performance and work place duties.[17,18] The use of HC's within the exercising population is reported to be 40-70%.[16,18] This is greater than that typically reported in the general population, with estimates between 30-40%,[19,20] but values as high as 48% have also been reported[21]. It should be noted that much of the existing literature has focused on HC use among exercising women and less is known specifically on the general population. Indeed, in some studies whilst the focus is on the general population they report variance in the level of physical activity individuals do, which may also contribute to the varied levels of HC use being reported[21]. Nevertheless, it would seem that women who participate more readily in exercise use HCs more than the general female population. Much of the current literature investigating HC use is solely focussed on the oral contraceptive pill (OCP); however, it is thought that there has been a recent rise in the use of long-acting contraceptives such as hormonal intrauterine systems (IUS) or contraceptive implants. This potential change in HC prevalence warrants further investigation and highlights the importance of including all forms of HC within research.[19] Therefore, the aim of this study is to describe the prevalence of different menstrual states, HC use, menstrual disturbances and dysfunction within an exercising female population. A secondary aim is to assess the influence of the MC and the use of HC on adherence to training and competition.

2. Material and methods

2.]. Participants and Study Design

Female users of the smart phone application STRAVA^{TM}, participated in the study (n=8,060). Following ethical approval from XXXX study recruitment and survey dissemination occurred via a hyperlink within the STRAVA^{TM} app (known as a 'dorado') or via email via the STRAVA^{TM} membership database. All participants had previously subscribed to receive marketing and research emails of this nature. Participants were included and eligible for the study if they were 18+ years and of a reproductive age, suffered any/or no MD, and were currently using any, or no, form of HC. Due to the overriding hormonal influence of some menstrual states, participants were not eligible for the study if they were peri or post-menopausal, had been pregnant and/or breastfed within the last year, or had undergone a hysterectomy. Commencement of the study occurred once participants had read and understood an information sheet and provided online consent.

A total of 425,697 invitations were sent (180,000 via email and 245,697 in dorado). Of the total invitations sent, 16,219 participants started the survey, with 10,592 women submitting the survey. Questionnaire responses were removed from the analysis if answers were incomplete, implausible, or not meeting the inclusion criteria (n = 236, 2.2%), had reported to have been pregnant (n = 341, 3.2%) or breastfeeding (n = 133, 1.3%) within the last year, or are menopausal/post-menopausal/undergone a hysterectomy (n = 1,822, 17.2%). An outline of the study recruitment is shown in Fig.1. The study was open for participation for a period of 25 days between 14th February 2019 and 11th March 2019. The study was not limited to participation within any specific sport modality (Fig.1). Sport modality participation was selected from a drop-down menu. Where the sport was not listed, participants listed this as "other". Significant other sports listed by >40 participants were as follows; CrossFit/cross training (n = 107), Pilates (n = 107), climbing/bouldering (n = 102), horse riding (n = 96) and high intensity interval training (n = 48).

For the purpose of this paper, and due to the inconsistency of the definitions within the current literature, menstrual states will be categorised as; amenorrhea, eumenorrhea 'regularly menstruating' (no ovulatory data was collected therefore this is assumed based on participant response), HC user, NonH IUD user, oligomenorrhea, polymenorrhea. All other menstrual related dysfunctions or disturbances, listed in table 1, will be referred to as menstrual dysfunctions (MD). NonH IUD users are identified as their own menstrual states due to the lack of concurrent evidence on their influence on performance, training and menstrual patterns in exercising women. There was no limit on the amount of weekly physical activity participants took part in.

2.2. Survey Design

The survey questionnaire was created by Bruinvels et al.[22]. Briefly, an anonymous 39-part cross sectional online questionnaire was created (www.surveymonkey.com; Survey-Monkey, London) to investigate demographic and menstrual cycle characteristics, exercise habits and hormonal contraceptive use in exercising women. Questions were also designed to understand perceptions of how the menstrual cycle and related symptoms currently and historically influence training and competition. The survey was made up of several question types including multiple choice, check boxes with or without a limit on the number of selections allowed, drop-down lists, matrix, sliders and free text where "other" was applicable. Where questions had leading answers, logic was applied to avoid irrelevant questions being asked.

To ensure clarity and suitability of the questions a small sample of participants (n = 20, ages: 18-40 yrs) completed a pilot survey. Pilot survey participants were asked to provide feedback on clarity of questions. Following feedback, minor changes were made (e.g., order of questions was amended and grammatical mistakes were corrected). The survey was developed to take approximately 10-minutes to complete. The survey was translated into French, Spanish, Brazilian Portuguese, German and American English, where it was piloted by a native speaker of that country to ensure correct meaning and colloquialism.

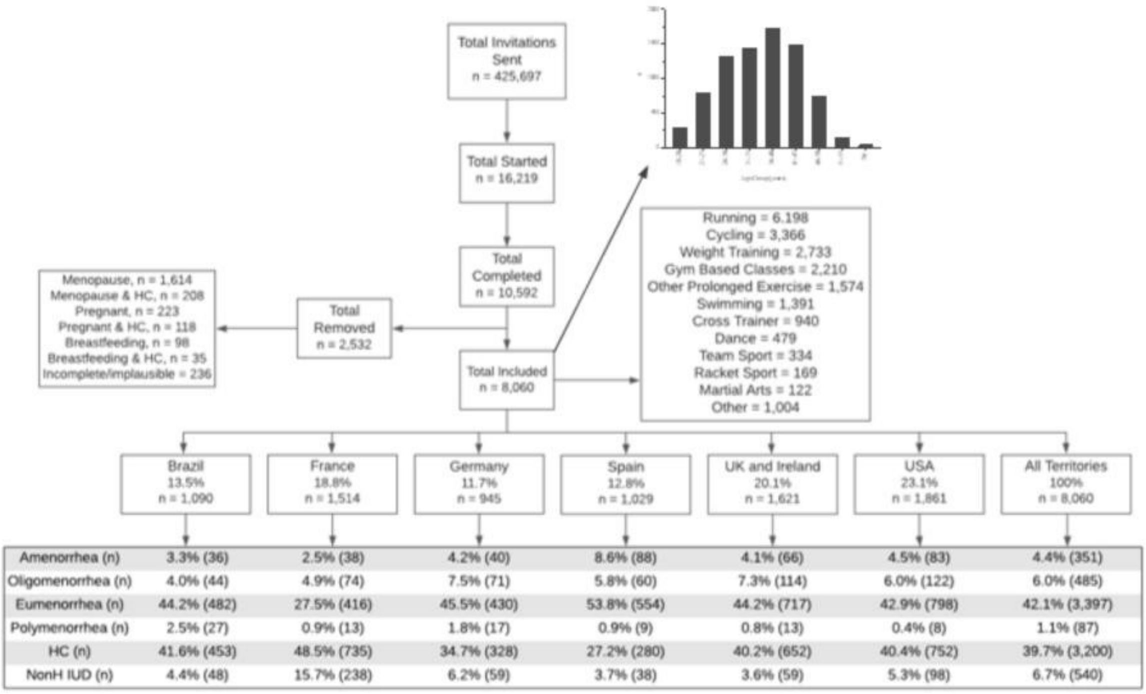


Fig. 1. Questionnaire respondents and menstrual states demographics by country *(n = 8,060)*, HC = hormonal contraceptive user, NonH IUD = non hormonal intrauterine device user.

2.3. Statistical Analysis

Data were exported directly from SurveyMonkey to Microsoft Excel software for Mac where they were coded for further analysis using R Studio (V 1.3.1093). Six aforementioned participant population groups were determined based on self-reported menstrual states within the last year and included: amenorrhoea, oligomenorrhea, eumenorrhea, polymenorrhea, HC user and NonH IUD user. Descriptive data are presented in numerical and graphical summaries, where frequency and/or percentage was adopted for categorical data where statistical significance was determined, all data were analysed using IBM SPSS Statistics, (v.28, Armonk, NY). A Kruskal-Wallis test was used to assess the effect of menstrual states on the likelihood of missing training or competition. Where a significant effect was identified, a *post-hoc* analysis incorporating Bonferroni adjustments was completed to determine where significance lies. An exploratory secondary analysis was conducted to guide future analysis in establishing any differences between commonly used HC types (Hormonal IUS vs OCPs) and progestin and combined methods on likelihood of missing training/races. A multinomial logistic regression was conducted to examine the association between hormonal contraceptive type and frequency of missed training and missed races. Missed training and races were treated as categorical data with four levels (e.g., yes frequently, yes sometimes, yes rarely, no never). No never was treated as the reference category. Odds ratios (OR) and 95% confidence intervals were calculated. Statistical significance was determined if $p<0.05$.

3. Results

3.]. Participant Demographics

Distribution of menstrual states per country and age group is shown in Fig 1. The mean (± standard deviation) body mass for the entire sample was 23.05 ± 3.68 kg/m^2. Fig. 2 shows distribution of exercise intensities for all participants. Within this cohort total weekly hours spent undertaking all forms of physical activity (e.g., high intensity, medium intensity, low intensity and weight training) ranged from 30 minutes to 40 hours across individuals, with on average 9 (± 6.7) total hours a week of physical activity performed.

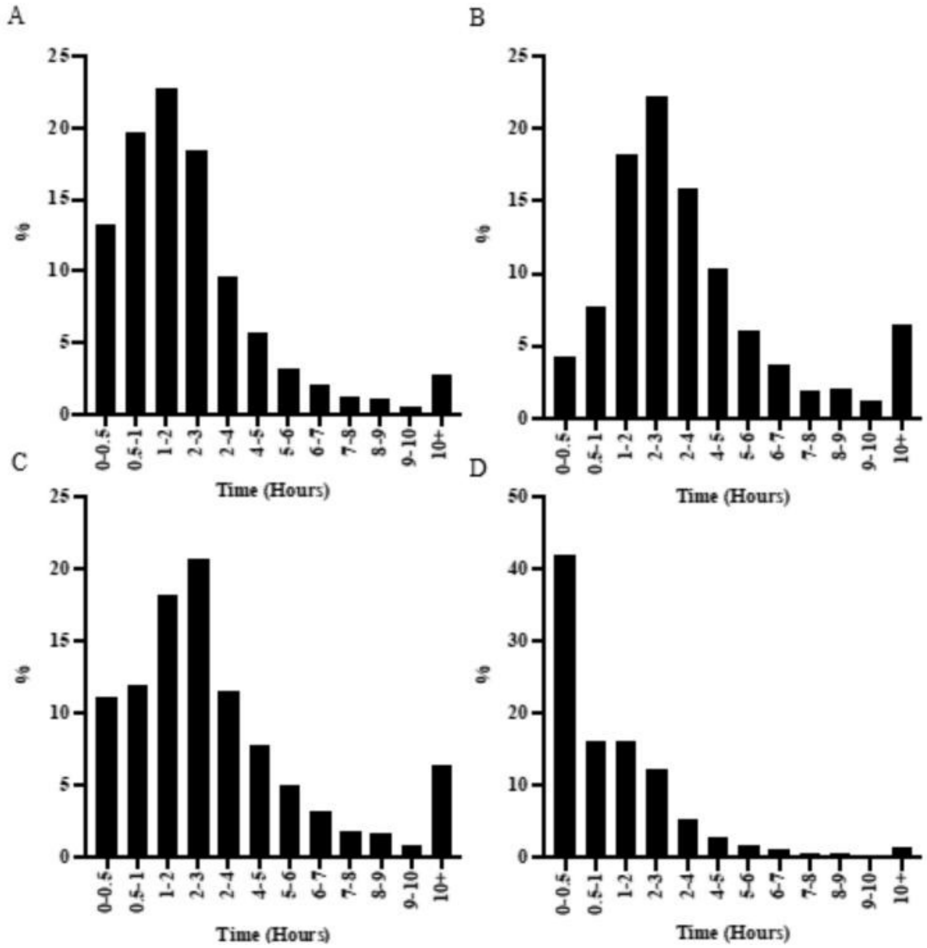


Fig. 2. Distribution of training intensities and weight training. *A*: high intensity training, *B*: moderate intensity training, *C*: low intensity training, *D*: weight training.

The prevalence of MDs is shown in table 1. Within the study population, the prevalence of amenorrhea, oligomenorrhea and polymenorrhea was 4.4%, 6.0% and 1.1%, respectively.

Table 1. Prevalence of menstrual dysfunction *(n = 8,060)*.

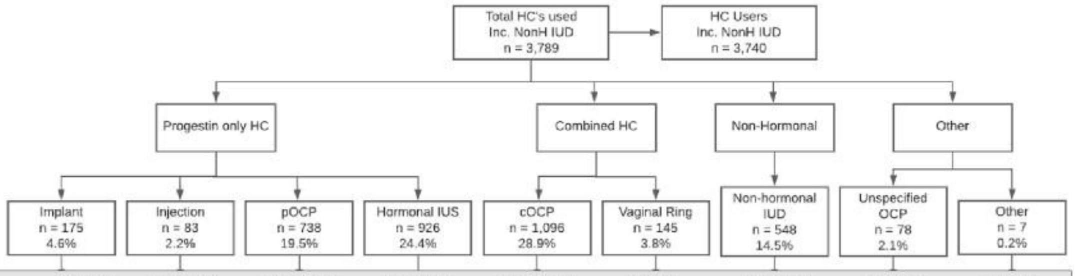
Dysfunction	n
Adenomyosis	43 (0.5%)
Bleeding Disorder	154 (1.9%)
Endometrial Polyps or Fibroids	456 (5.7%)

Endometriosis	340 (4.2%)
Excess Prolactin Production	65 (0.8%)
Ovarian Cysts	909 (11.3%)
Pelvic Inflammatory Disorder	82 (1.0%)
Polycystic Ovary Syndrome	636 (7.9%)
Premature Ovarian Failure	27 (0.3%)
No Dysfunction	5,831 (72.3%)

Note: 549 participants reported more than one dysfunction.

3.2. Hormonal Contraceptive Use

The prevalence of HC use per country is shown in Fig 3. Of the participants included within this study, 39.7% (n = 3,200) participants were using one or more forms of HC. An additional 6.7% (n = 540) were currently using a NonH IUD as their form of contraceptive. Eleven participants reported to currently be using more than one form of HC. The most frequent mode of delivery of HC was the OCP with 50.5% of HC users choosing this delivery method (combined OCP (cOCP) = 28.9%; progestin only OCP (pOCP) = 19.5%; unspecified OCP = 2.1%). The second most frequent mode of delivery was the hormonal intrauterine system (IUS) (24.8%), followed by the implant (4.6%), vaginal ring (3.8%) and injection (2.2%), with 0.2% of participants not specifying HC mode of delivery.



Brazil, n (% of total n)	2 (0.6%)	31 (6.1%)	151 (29.6%)	90 (17.6%)	173 (33.9%)	5 (1%)	49 (9.6%)	2 (0.6%)	7 (1.4%)
France, n (% of total n)	49 (5%)	5 (0.5%)	275 (27.9%)	192 (19.5%)	204 (20.7%)	13 (1.3%)	241 (24.5%)	5 (0.5%)	0 (0%)
Germany, n (% of total n)	7 (1.8%)	5 (1.2%)	102 (25.8%)	89 (22.5%)	97 (24.6%)	31 (7.8%)	61 (15.4%)	3 (0.8%)	0 (0%)
Spain, n (% of total n)	8 (2.5%)	3 (0.9%)	41 (12.7%)	83 (25.6%)	90 (27.8%)	57 (17.6%)	38 (11.6%)	4 (1.2%)	0 (0%)
Uk & Ireland, n (% of total n)	76 (10.5%)	26 (3.6%)	84 (1.2%)	194 (26.8%)	222 (30.7%)	1 (0.1%)	60 (8.3%)	60 (8.3%)	0 (0%)
USA, n (% of total n)	33 (3.8%)	13 (1.5%)	85 (9.9%)	278 (32.3%)	310 (36%)	38 (4.4%)	99 (11.5%)	4 (0.5%)	0 (0%)

Fig. 3. Prevalence and delivery method of hormonal contraceptive use (including non-hormonal IUD) *(n = 3,740)*. cOCP = combined oral contraceptive pill, HC = hormonal contraceptive, IUD = intrauterine device, IUS = intrauterine system, OCP = oral contraceptive pill, pOCP = progestin only oral contraceptive pill.

When comparing all combined HC methods with progestin only HC methods, multinominal logistic regression showed no statistically significant different between either groups for frequently missing training (OR = 1.26, 95% CI [0.97, 1.631, p = .080), sometimes missing training (OR = 0.78, 95% CI [0.60, 1.031, p = .075) or rarely missing training (OR = 1.12, 95% CI [0.86, 1.451, p = .414). There was no statistically significant difference between either groups for frequently missing races (OR = 1.06, 95% CI [0.67, 1.691, p = .806), sometimes missing training (OR = 0.92, 95% CI [0.55, 1.531, p = .734) or rarely missing training (OR = 1.35, 95% CI [0.80, 2.271, p = .260).

When comparing the association between contraceptive type hormonal IUS vs OCP and frequency of missed training sessions, hormonal IUS users were significantly more likely than OCP users to frequently miss training (OR = 1.77, 95% CI [1.30, 2.401, p < .001) and rarely miss training (OR = 1.68, 95% CI [1.23, 2.291, p = .001). The association with sometimes missing training did not reach statistical significance (OR = 1.37, 95% CI [0.99, 1.891, p = .056). Hormonal IUS users were also significantly more likely than OCP users to report frequently missing races (OR = 2.23, 95% CI 111.22, 4.10], *p* = .010) and sometimes missing races (OR = 1.93, 95% CI 111.00, 3.72], *p* = .050). There was no significant different between the two groups for rarely missing training (OR = 1.83, 95% CI 110.95, 3.55], *p* = .071).

3.3. Menstrual Cycle Influence on Training and Competition

The influence of menstrual states on training and competition is shown in table 2. A Krusal-Wallis test identified an association between menstrual states on missing or changing training ($\chi^2(5) = 102$, $p < 0.001$). Participants who were using HC were significantly less likely to miss training than those who were eumenorrheic ($P < 0.001$) or had polymenorrhea ($P = 0.048$). An association was also determined between menstrual states and likelihood of missing a race/event/competition ($\chi^2(5) = 61.4$, $p < 0.001$). Those identified to have polymenorrhea were significantly more likely to miss a race/event/competition than those with oligomenorrheic ($P<0.001$) or HC users ($P<0.001$). In addition, HC users were significantly less likely to miss a race/event/competition than those with a eumenorrheic cycle ($P<0.001$).

Table 2. Influence of menstrual cycle or menstrual related symptoms on training and competition, mean ± SD.

	Amenorrhea *(n = 35])*	Oligomenorrhea *(n = 485)*	Eumenorrhea* #ǂ *(n = 3,397)*	Polymenorrhea *#† *(n = 87)*	HC user *(n = 3,200)*	NonH IUD user *(n = 540)*	Total *(n = 8,060)*
Miss or change training							
Yes, frequently (every cycle)	57 (16.2%)	56 (11.5%)	500 (14.7%)	18 (20.7%)	311 (9.7%)	64 (11.9%)	1,006 (12.5%)
Yes, sometimes (every few cycles)	95 (27.1%)	153 (31.5%)	1,198 (35.3%)	27 (31.0%)	952 (29.8%)	176 (32.6%)	2,601 (32.3%)
Yes, rarely	82 (23.4%)	144 (29.7%)	797 (23.5%)	20 (23.0%)	786 (24.6%)	142 (26.3%)	1,971 (24.5%)
No, never	117 (33.3%)	132 (27.2%)	902 (26.6%)	22 (25.3%)	1,151 (36.0%)	158 (29.3%)	2,482 (30.8%)
Miss a race/event/competition							
Yes, frequently (every cycle)	19 (5.4%)	13 (2.7%)	130 (3.8%)	7 (8.0%)	77 (2.4%)	14 (2.6%)	260 (3.2%)
	40 (11.4%)	34 (7.0%)	370 (10.9%)	16 (18.4%)	283 (8.8%)	62 (11.5%)	805 (10.0%)
	33 (9.4%)	63 (13.0%)	429 (12.6%)	10 (11.5%)	297 (9.3%)		896 (11.1%)

Yes, sometimes (every (72.7%)	259 (73.8%) 375 (77.3%) 2,468 (79.5%)	54 (62.1%) (11.9%)	2,543 (75.7%)	64	6,099few cycles)
Yes, rarely				400	
No, never				(74.1%)	

HC = hormonal contraceptive. * Significantly more likely to miss training than HC user, ǂ Significantly more likely to miss training than amenorrhea, # Significantly more likely to miss competition than HC user, † Significantly more likely to miss competition than Oligomenorrhea *($p<0.05$)*.

4. Discussion

The aim of this study was to describe the prevalence of different menstrual states, hormonal contraceptive (HC) use, and menstrual dysfunction (MD), within an exercising female population. In addition, we sought to identify the impact that this has on training and performance. Descriptive data from 8,060 exercising females of reproductive age indicated that most participants were apparently eumenorrheic (42.1%), closely followed by 39.7% who reported using one or more forms of hormonal contraception. When comparing hormonal contraceptive methods, there was no significant difference between combined and progestin only HC methods. There were however, significant differences between hormonal IUS and OCP users in likelihood of missing training and races. To our understanding this is the largest study establishing menstrual states and HC use in exercising women across multiple geographical regions and will be important to help guide practitioners and researchers. In addition to the distribution of menstrual states and prevalence of MD, a novel and notable finding of this study is that menstrual states were associated with the perceived impact of the MC on training and competition, with polymenorrhea being the menstrual state reported to most significantly disrupt both training and competition adherence.

Much of the research to date, has identified that female athletes are more likely to experience some form of menstrual disturbance or dysfunction when compared to the general, non-athletic female population.[9,23,24] One such study,[10] determined that up to one third of exercising women might experience amenorrhea, with half of this population reported to have a subtle MD. In contrast to this finding, the present study demonstrated that only 4.4% of exercising woman across the six countries experienced amenorrhea, with 72.3% reporting no other MD. Prevalence of oligomenorrhoea in the present study was 6.0%, which is higher than that reported by De Souza et al.[10] However, a large-scale study of over 12,000 women of a reproductive age in China found 12.2% of the general population to be oligomenorrheic,[25] greater than that identified here. The disparity in results between these studies is likely to be multifactorial; for example, sport modality, intensity and volume are likely to have an effect. However, this may also be, in part, explained by the effect of ethnicity on the menstrual cycle.[26] An epidemiological study analysing MC dysregulation risk factors in 309 women, reported that, Asian participants were more likely to have longer cycles when compared to Caucasian women.[7] Beyond the potential genetic heterogeneity between ethnic groups, exercise modality and volume, the MC can be influenced by external differences including but not limited to, culture, diet and medical conditions.[27] Due to the multi-country nature of the present study and the large sample size, these factors could explain differences in findings. It also should be acknowledged that more discussion and awareness around this topic over recent years may well be helping to educate individuals about the risks associated with oligomenorrhoea and amenorrhoea, which may reduce rates.

The prevalence of MD was notable, with 27.7% reporting at least one type of MD. This rate is relatively high, given that MD's are often undiagnosed, and diagnosis can take years. For example, there is a 4-11 year delay from onset of symptoms to diagnosis of endometriosis.[28] Ovarian cysts and polycystic ovarian syndrome (PCOS), which may alter MC length, cause pain and irregular bleeding patterns, were the most commonly reported dysfunction in the present study. Ovarian cysts are generally undiagnosed and can be asymptomatic, therefore estimating the prevalence within the general female population is challenging.[29] It has been suggested that approximately 7% of women will have some form of ovarian cyst within their lifetime.[30-32] It is significant in this exercising population that 11.3% reported having had a cyst, this warrants further investigation. Diagnostic challenges have meant that understanding the prevalence of PCOS has also proven problematic. A systematic review stated the prevalence could lie in a range of 4-20% of women of a reproductive age.[33] There is also some suggestion that prevalence may be greater in the athletic population than in the general population, due to the potentially higher levels of testosterone in women with PCOS which could have athletic performance advantages.[34] Given the significant prevalence here, further research and education needs to be provided to help athletes and practitioners recognise the signs and symptoms for these potentially debilitating conditions, along with addressing potential management strategies. In addition, more research is essential to help improve diagnosis, reduce symptoms and to investigate the influence of exercise on MDs and the influence of MDs on participation and performance in exercise.

The prevalence of hormonal contraceptive use in this study is consistent with previous research.[16,35,36] The cOCP was the most commonly delivered method of HC within the total population of this study, accounting for over half of all HC used. Interestingly, further examination of HC use by country revealed that pOCP use was greater than cOCP use in both France and Germany. IUS use was also relatively high, being the second most popular form of HC overall, with use being highest in the USA, UK, Ireland and Spain. The reported IUS use in this study was higher than in previous research,[16] potentially suggesting a shift in trend. The between-country variation in HC use is notable, and should be accounted for in future research. When comparing pOCP to cOCP HC use, the results are contrary to a previous review.[16] Progestin-only HC's make up 50.7% of all HC's used within the current sample, 20.7% higher than that reported by Martin et al.[16] This disparity in prevalence of use may be due to different guidance within the territories and the varying performance level of the participants. Martin et al.,[16] only included elite level athletes from the UK, whereas the current sample included exercising women of all abilities.

As part of an exploratory analysis, and to generate future hypothesis, comparisons were made between hormonal contraceptive (HC) types and the likelihood of missing training sessions or competitions. To the authors' knowledge, this is the first study to investigate this association. The findings indicate when combined and progestin-only HC methods were analysed as broad categories, no statistically significant differences were observed. However, when comparing the two most common HCs methods, hormonal IUS and OCPs (cOCP and POP), significant differences particularly in the reporting of missing training were observed, with those using hormonal IUS more likely to miss training. These findings differ slightly from previous research, which reported more positive perceived training impacts among hormonal IUD users compared with OCPs users[37]. It should be noted though, the current research assessed actual training impacts compared to perceived impacts of previous research[37]. The choice to use HCs is highly individual and influenced by factors beyond training outcomes, therefore individuals should always seek professional medical advice when selecting a contraceptive method. Nevertheless, the present findings suggest that specific HC types may differentially affect training consistency, with OCP use, within the current participant cohort, associated with a lower likelihood of missing training sessions or races. As this was an exploratory analysis within the current research, it would be prudent for future research to specifically examine this to clarify whether distinct forms of contraceptive methods differentially effect performance or training.

As suggested by previous research, HC use in exercising women is commonplace in part due to the convenience of manipulating menses and reducing the perceived negative impact of menses on performance.[17]A noteworthy finding of this study was that adherence to both training and competition/event/race were influenced by menstrual states and HC use. Those using one or more forms of HC were less likely to report missing training than those with polymenorrhea or those with a eumenorrheic cycle. In addition, HC users are also less likely to miss a race/competition or event than those with eumenorrhea or polymenorrhea. While this is interesting, it is important to note that this may be confounded by irregular or absent bleeding associated with HC use. In addition, the study only demonstrated this to be a small effect so should be interpreted with caution. In opposition to this potential positive impact of HC use, a systematic review demonstrated that HC use, specifically the cOCP, may in fact have a negative impact on performance.[38] Additionally, research has demonstrated that those using the cOCP had higher concentrations of C-Reactive Protein and oxidative stress when compared to exercising women with a 'natural' cycle.[39] This could suggest that cOCPs may have a negative effect on recovery and training stress.[38] Use of HC can be advised as a means to control and manipulate the MC, and therefore negate the perceived negative side effects of menses and/or dysmenorrhea.[40] Somewhat unsurprisingly, those with polymenorrhea were more likely to miss training and competition, when compared to those with eumenorrhea, oligomenorrhea, HC users and

NonH IUD users. The increased likelihood of missing or changing training may be due to the increased occurrence of menses, which athletes have previously reported to be the predominant phase of their MC that negatively impacts their training.[17]

There are a number of limitations to this study. Firstly, the current set of data was collected in 2019 and therefore represents the trend of uses at that time. Readers are encouraged to take this into account when interpreting the results as they may differ if retested. Additionally, due to the nature of the dissemination of the questionnaire (via STRAVA), this study may be biased to include exercising females more inclined to use technology for their training. In addition, questionnaires require participants to interpret questions and accurately recall historic events, leaving a degree of potential inaccuracy. When determining the effect of menstrual states on training and competition, the question was worded to include historic and present experiences, therefore their answers may be biased by past situations. To improve accuracy, future studies should consider longitudinal data collection to improve accuracy of identifying menstrual states and the effects that this may have on exercise. It is also important to note that some participants may be experiencing undiagnosed medical causes of menstrual disfunction and thus would not be able to report this. Finally, when referring to individuals with an eumenorrheic cycle, due to the distant nature of the study, we have assumed ovulation occurs for these individuals.

The primary and novel strength of this research is the large sample size from over six different territories. To date, there is very limited evidence of the distribution of menstrual states, HC use and MD within the exercising female population of reproductive age. This study provides categorical information necessary to understand the subpopulations within an exercising population, necessary for future, more targeted research within female athletes. In addition, this study is not limited to one modality of sport and was open to participants of any sporting background.

5. Conclusion

This study highlighted the prevalence of different female health states within an exercising female population and as such should inform practitioner awareness and future research direction. The majority of participants were either eumenorrheic or using combined or progestin-only hormonal contraception. Contrary to findings in previous literature, the prevalence of amenorrhoea and oligomenorrhoea was relatively low, however, this study did not take into consideration the activity level or ability of the participants. Significantly, prevalence of MD such as PCOS and ovarian cysts are relatively high. Further, results from this study suggest different hormonal contraceptive types may differentially affect training and competition adherence, specifically with hormonal IUDs more likely to affect training than OCPs, this warrants further exploration though. Adherence to training or competition may be affected by MDs, menstrual states and hormonal contraceptive type.

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