TITLE

Prevalence of hormonal contraceptive use and reported side effects of the menstrual cycle and hormonal contraceptive use in powerlifters and rugby players

ABSTRACT

OBJECTIVES:

The prevalence of hormonal contraceptive (HC) use and the associated symptomology of use or non-use are under-studied in athletic populations, and in particular, in strength and collision sports. This study aimed to investigate the prevalence of hormonal contraceptive use and reported side effects of the menstrual cycle and hormonal contraceptive use in powerlifters and rugby players.

METHODS:

Competitive female powerlifters and rugby players (aged ≥18 y), representing a strength and a collision sport respectively, completed an anonymous online questionnaire for the purpose of assessing self-reported prevalence of HC use, and symptoms of the menstrual cycle and HC use. Athletes were categorized by sport (powerlifters, n=149; rugby players, n=135) in order to conduct a stratified analysis. For open-ended questions, a content analysis was conducted to categorize responses, and frequency analyses were performed.

RESULTS:

Current HC use was reported by 51.1% of athletes, with similar prevalence for the two sports (powerlifting, 48.3% vs. rugby, 54.1%, P=0.34). Side effects of the menstrual cycle were reported in 83.5% of non-HC users, with the most common being unspecified cramping (42.4%), headache/migraine (24.5%), and fatigue (24.5%). Side effects were reported in 40.0% of HC users, with the most common being mood changes (17.9%), stomach pain (8.3%) and headaches/migraines (6.9%).

CONCLUSION:

A large proportion of HC users and non-users in this study experience negative side effects of HC use and the menstrual cycle, respectively. The symptoms experienced by both groups are wide-ranging, with a high degree of variation between individuals. The negative side-effects experienced by HC users and non-users may have an influence on athletic performance, and this requires future investigation.

KEYWORDS

collision sports; female; menstruation; pain; strength sports;

INTRODUCTION

The menstrual cycle is an important biological process that occurs between menarche (first menstrual cycle and bleeding) and menopause (permanent cessation of the menstrual cycle), and is characterized in eumenorrheic women by a significant, measurable cyclical variation of endogenous sex hormones, namely estrogen and progesterone [1]. Notably, the shifting hormonal milieu experienced by eumenorrheic women may influence athletic performance at different stages of the menstrual cycle [2,3]. A large proportion of eumenorrheic women experience negative side-effects and symptoms associated with these hormonal fluctuations at different phases of the menstrual cycle [4–6], with a large proportion of athletes (i.e., 50.0% to 84.6%) perceiving the menstrual cycle to have a direct negative effect on their performance in training and competition [7,8].

Hormonal contraceptives (HCs) are defined by the administration of exogenous hormones that affect the endocrine regulation of the female reproductive system, and may inhibit ovulation [9,10]. HC users display a hormonal profile of consistently low endogenous sex hormone concentrations, which induces amenorrhea [11]. HCs are administered by a variety of delivery methods, with oral contraceptives (OC) being the most common delivery method in both general population and athletic cohorts [6,12–14]. HCs are also classified by the hormones employed; combined HCs having both a progestin and estrogenic component, while other HCs having a progestin only component. The differing profiles of HCs may produce variations in their physiological effects and subsequent side-effects, and therefore, may differ in their potential influence on athletic performance [15]. There is equivocal evidence regarding the influence of hormonal contraceptives on exercise performance and chronic training adaptations, with studies reporting HC-use having a positive, negative and neutral influence on adaptation to resistance training [16–21].

Although menstrual function is acknowledged as a critical element of female athlete health, there is a sparsity of research examining the symptomology of the menstrual cycle and prevalence of HC use in athletic populations [3,15]. Prevalence of HC use has been reported to be higher in athletic populations (40.2% to 49.5%) than in the general population (27.0% to 46.0%) [13,22]. The higher prevalence of HC use in athletic populations may be due to the use of HC to minimize the perceived negative side-effects of the menstrual cycle and to control menstruation [6,14,23]. For example, one recent study in elite athletes has shown HC users to experience fewer negative side-effects compared to non-HC users [6].

The limited research to date on the symptomology of the menstrual cycle and prevalence of HC use in athletic populations has primarily focused on endurance athletes and non-collision team sports. Few data exist for strength or collision sports. The nature of these sports is unique as the physiological determinants and demands of performance differ greatly to that of sports previously researched. Compared to other sports examined to date, strength or collision sports place greater emphasis of development of strength and lean body mass, and the training demands in terms of energy expenditure would be lower than endurance sports [24–26]. Whether chronic resistance training, or repeated collisions, especially to the torso, influence perceived symptomology is yet to be investigated. Therefore, this study investigated prevalence of HC use and the symptomology of the menstrual cycle or HC use specifically in powerlifting and rugby, as they are representative of sports where the practice of resistance training is highly utilized and attainment of greater lean body mass and high levels of maximal strength are viewed as key performance indicators, but importantly, these sports differ in the presence or absence of collisions and on-field conditioning work.

MATERIALS AND METHODS

Experimental approach to the problem

Competitive female powerlifters or rugby players (aged ≥18 y) completed an anonymous online questionnaire through a link shared via professional networks and social media platforms using a modified questionnaire previously established for the purpose of assessing self-reported symptomology of the menstrual cycle and HC use [6]. The questionnaire was recreated in Google Forms and was open for three weeks beginning October 19th, 2020.

Subjects

The study was approved by the Research Ethics Committee at the ANONYMISED, Ireland (permit: ANONYMISED), in accordance with the Declaration of Helsinki. Subjects provided informed consent through a tick box option in order to proceed to the questionnaire. A convenience sample of 286 athletes accepted the study invitation and completed the survey, with 284 responses included in the final analysis (Figure 1). Inclusion criteria were that subjects had to self-report as being i) a biological female, ii) aged ≥18 y, iii) pre-menopausal, and iv) actively competing in the sport of either powerlifting or rugby.

Data analysis

Statistical analyses were performed using SPSS (Version 24.0, IBM Corp., Armonk, NY). To prevent duplicate data, the database was searched for non-unique dates of births and identical values were visually checked to assess whether the responses were different. Descriptive statistics (i.e., mean, SD, and frequency analysis) were used to display subject characteristics and responses to survey questions providing ordinal data. Athletes were categorized by their sport (powerlifter or rugby player) in order to conduct a stratified analysis.

For open-ended questions, a content analysis was conducted to categorize responses, and a frequency analysis performed. Assumptions of normality were checked using the Kolmogorov-Smirnov test. Between-group differences were examined using independent sample t-tests. Pearson's chi-squared (X^2) tests were used to examine the relationship between categorical variables, with Fisher's exact tests used where <80% of expected cell counts were >5 [27]. Duplicate responses were identified via visual inspection and removed. Data are represented as mean±SD, frequencies and percentages, and the threshold for statistical significance was set at $p \leq 0.05$.

RESULTS

Subjects and prevalence of HC use

Subject characteristics are detailed in Table 1. HC users were significantly older than non-HC users (28.12±7.27 vs. 25.83±5.92 y; $P=0.004$). Rugby players commenced training (17.39±6.10 vs. 24.78±6.84 y; $P \leq 0.001$) and competing (18.45±5.42 vs. 25.62±6.90 y; $P \leq 0.001$)) in their chosen sport at a significantly younger age that the powerlifters. Subjects consisted predominantly of Europeans (65.8%) and North Americans (19.0%), respectively. The rugby cohort consisted of varying competitive statues ranging from International/National (25.2%) and provincial/club (74.8%), respectively.

An approximately even split between sports was reported [powerlifting, n=149 (52.5%); rugby, n=135 (47.5%)]. One hundred and forty-five (51.1%) athletes reported being a current HC user, with the remaining 48.9% not currently using any form of HC, although 4.0% of which were using non-hormonal intrauterine devices (Figure 1). Participation in either sport did not influence HC use ($X^2_1=0.9$, $P=0.34$) with similar prevalence between the two groups observed as 48.3% and 54.1% in powerlifting and rugby, respectively.

Menstrual cycle (non-HC users)

83.5% of non-HC users reported side effects of the menstrual cycle (Table 2), with the most common being unspecified cramping (42.4%), headache/migraine (24.5%), and fatigue (24.5%). 6.5% of non-HC users described themselves as amenorrhoeic (defined as having missed more than three consecutive periods). The average menstrual cycle length for the remaining athletes was 29.2±3.3 d, with 69.1% of athletes reporting their menstrual cycle as variable in length. 18.0% and 13.7% of athletes described themselves as having menorrhagia (defined as abnormally heavy bleeding during their period) and being oligomenorrheic (defined as a menstrual cycle length of greater than 35 days), respectively.

Chi-square analysis revealed significant differences between sports for prevalence of unspecified cramp (powerlifting, 33.8% vs. rugby, 53.2%; X^2_1=5.3, P=0.016), and abdominal pain (powerlifting, 18.2% vs. rugby, 6.5%; X^2_1=4.2, P=0.034). No other differences were found between the sports in reported side effects or symptomology of the menstrual cycle (all P>0.05).

HC use

40.0% of HC users reported side effects of HC use (Table 3), with the most common being mood changes (17.9%), abdominal pain (8.3%) and headaches/migraines (6.9%). The most prevalent form of HC delivery reported were oral contraceptives (55.2% of HC users). Length of use ranged from ≤6 months (n=5) to ≥5 years (n=41). 30.0% of oral HC users reported never engaging in the 7 “pill-free” days each cycle, while 45.0% reported always observing the 7 “pill-free” days.

Chi-square analysis revealed a significant difference between sports for prevalence of mood changes (powerlifting, 11.1% vs. rugby, 24.7%; X^2_1=4.5, P=0.027). No other differences were found between the sports in reported side effects or symptomology of HC use (all p>0.05).

DISCUSSION

This investigation of the symptomology of the menstrual cycle and prevalence of HC use in athletic populations is the largest to date in a rugby cohort, and the only study in powerlifters. This study thereby provides new data for sports with a considerable demand for strength and power component, and additionally those with collision events. Approximately half of the female athletes in this study were current HC users, and participation in powerlifting or rugby did not result in a difference in prevalence of use. HC users and non-HC users alike experienced varying degrees of negative side-effects of HC use and of the menstrual cycle, with side effects being greater in non-HC users regardless of sport.

The prevalence of HC use of 51.1 % in this athlete cohort is higher than that previously reported for the general population, which varies in the reported prevalence of use (21.2% to 46.0%) [12,13,28], and is similar to the prevalence of 49.5% recently reported in elite female athletes from a range of sports [6]. As previously stated, the greater prevalence of HC use in athletic populations may be due partly to the perception by athletes that they can better predict and control menstruation, and attempting to avoid menstruation during periods of competition or training of heightened importance [6,14]. An important related point, especially given the high prevalence of HC use in athletes, is that many athletes equate the withdrawal bleed experienced during the “pill-free” days of HC use with a menstrual bleed. This confusion may lead to athletes and coaches alike assuming an athlete is eumenorrheic when HC use may be masking menstrual dysfunction [29]. Given that menstrual dysfunction is an important

indicator of Relative Energy Deficiency in Sport (RED-S) [30], and the recent call for positive communication around the menstrual cycle in this context [31,32], increasing awareness of this issue of 'masking' may be important amongst athletes and practitioners.

A large proportion (83.5%) of non-HC users experienced negative side-effects of the menstrual cycle with the most cited symptoms being cramping, headache/migraine and fatigue. Athlete type (powerlifter vs. rugby player) had an influence on the reported symptoms, with rugby players reporting higher incidence of "*unspecified cramp*" (53.2% vs. 33.8%), and powerlifters reporting higher incidence of "*abdominal cramp*" 18.2% vs. 6.5%). Presently, we attribute this finding as an artefact of the terminology of the questionnaire coupled with the content analysis employed. When an athlete reported cramp as a symptom, but did not directly state it as an abdominal cramp, it was categorized as "*unspecified cramp*". When the respective data for "*unspecified cramp*" and "*abdominal cramp*" are combined for each sport, there is no difference between sports. The prevalence of reported negative side-effects of the menstrual cycle in non-HC users are similar to those previously reported (74 to 93%) [5,6,8,33], indicating that the focus on strength training, with or without the presence of collision events, in these sports does not have a unique influence on symptom prevalence for the menstrual cycle.

HC users had lower prevalence of negative side-effects (40.0%) of HC use, when compared with symptom prevalence for the menstrual cycle in non-HC users in this study. The most common reported side-effect of HC use was mood changes (e.g., increased anxiety, depressive symptoms, or increased irritability). With 17.9% of HC users reporting this symptom, this is almost identical to the prevalence of the same symptom in the non-HC users (18.0%). Athlete type was shown to have a significant influence on mood changes, with the

24.7% incidence in rugby players being higher than the 11.1% in powerlifters. A physiological basis to explain this finding is lacking at present, but a speculative explanation may be that the individual versus team-based nature of the respective sports could influence the athlete's awareness and perception of this symptom. Alternatively, this may be an incidental finding.

The data presented in this study highlight the importance for athletes and coaches to have an open dialogue regarding menstrual cycle function and HC use. Both HC and non-HC users experience negative side-effects, which may have an influence on performance in training and competition [3,8,15,34]. We recommend that coaches adopt an accommodating culture in which flexibility may be permitted to accommodate for those athletes experiencing severe symptoms of the menstrual cycle or HC use.

This study collected responses representing a wide, geographical spread, but a limitation is that we did not record the ethnicity of the respondents. Whether ethnicity influences the physiological response to, and symptoms perceived by HC and non-HC using athletes is yet to be investigated. Another limitation of this study is that specific details relating to contraceptive use such as the type of OC, brand name, progestins used, were not collected, meaning that a deeper analysis of the association of symptoms with these variables could not be performed. Such an analysis would be of interest in future studies. Future studies should also consider the effects of the length of use of HCs on aspects of health, training and performance, as 28.2% of HC users in this study have used HC continually for ≥5 years. These long-term implications are not yet understood, and are particularly important given that a third of respondents in this study do not follow best practice guidelines for HC use by observing the monthly "*pill-free*" time period.

In conclusion, approximately half of the athletes in this study used HCs, and a large proportion of HC users and non-users experience negative side-effects of HC use, and of the menstrual cycle, respectively. The symptomology experienced by HC and non-HC users is wide-ranging, with a high degree of variation between individuals, but prevalence in these strength and collision sport athletes is broadly consistent with that reported in other athletes.

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TABLES AND FIGURES

FIGURE LEGEND

Figure 1. The prevalence of hormonal contraceptive (HC) use and perceived negative side-effects of the menstrual cycle and HC use. IUD, intrauterine device

Table 1. Subject characteristics

	Whole Cohort			Rugby Cohort			Powerlifting Cohort		
	Total (n=284)	**Non-HC Users (n=139)**	**HC Users (n=145)**	**Total (n=135)**	**Non-HC Users (n=62)**	**HC Users (n=73)**	**Total (n=149)**	**Non-HC Users (n=77)**	**HC Users (n=72)**
Age (y)	26.95±6.70	28.12±7.27	25.83±5.92*	25.32±5.94†	25.84±6.49	24.88±5.44	28.43±7.02	29.96±7.39	26.79±6.25
Height (m)	1.65± 0.08	1.65±0.09	1.66±0.07	1.66±0.09†	1.66±0.11	1.67±0.07	1.64±0.07	1.64±0.07	1.64±0.07
Body mass (kg)	72.86±16.99	73.58±17.52	74.12±16.52	75.67±15.79	75.94±16.56	75.44±15.22	72.22±17.90	71.69±18.14	72.79±17.74
Age began training (y)	21.26±7.47	22.82±7.97	19.77±6.64*	17.39±6.10†	18.73±7.07	16.25±4.90*	24.78±6.84	26.12±7.11	23.35±6.28*
Age began competing (y)	22.21±7.18	23.96±7.37	20.53±6.60*	18.45±5.41†	20.24±5.87	16.93±4.51*	25.62±6.90	29.96±7.11	24.18±6.39*
Weekly training duration (h)	7.62±3.52	7.80±3.54	7.44±3.52	5.8±2.97†	5.66±2.48	5.92±3.34	9.26±3.17	9.52±3.33	8.99±2.99

*indicates a significant difference between hormonal contraceptive (HC) user and non-HC users within the indicated cohort ($p \leq 0.05$); †indicates a significant difference between rugby and powerlifting for "Total" column ($P \leq 0.05$)

Table 2. Frequency analysis of side effects in non-hormonal contraceptive users (n=139)

Symptom	Frequency	Prevalence (%)
Unspecified cramp	59	42.4
Headache / migraine	34	24.5
Tiredness / fatigue / lethargy	34	24.5
Mood changes	25	18.0
Back pain	22	15.8
Stomach pain / abdominal cramps	18	12.9
Bloating	14	10.1
Nausea / sickness /vomiting	12	8.6
Sore breasts	11	7.9
Irritability	10	7.2
Increased appetite	7	5.0
Unspecified pain	6	4.3
Diarrhoea / digestive issues	6	4.3
Poor skin	5	3.6
Sleep disturbances	5	3.6
Hot flushes / increased sweating	4	2.9
Decreased appetite	4	2.9
Dizzy / lightheaded / lack of coordination	3	2.2
Muscle ache	3	2.2
Weakness	3	2.2
Leg discomfort	2	1.4
Constipation	2	1.4

Problems with exercise	2	1.4
Flustered / lack of focus	2	1.4
Pre-menstrual syndrome	2	1.4
Heavy bleeding	1	0.7
Increased heart rate	1	0.7
Vaginal pain	1	0.7
Shortness of breath	1	0.7
Colic	1	0.7
Cold chills	1	0.7
Excessive salivating	1	0.7
Weight gain	1	0.7
Increased libido	1	0.7
Increased energy	1	0.7
Water retention	1	0.7
Excessive thirst	1	0.7
Increased night-time urination	1	0.7

Table 3. Frequency analysis of side effects in hormonal contraceptive users (n=145)

Symptom	Frequency	Prevalence (%)
Mood changes	26	17.9
Stomach pain	12	8.3
Headaches / migraines	10	6.9
Poor skin	8	5.5
Tiredness / fatigue / lethargy	8	5.5
Bloating	7	4.8
Weight gain	6	4.1
Breast Issues (swollen or sore)	5	3.4
Spotting	5	3.4
Irregular period	4	2.8
Loss of period	4	2.8
Negative effect on performance	4	2.8
Nausea / sickness / vomiting	2	1.4
Water retention	2	1.4
Increased appetite	2	1.4
Back pain	2	1.4
Heavier period	2	1.4
Decreased appetite	2	1.4
Reduced libido	2	1.4
Altered cycle length	1	0.7
Painful period	1	0.7
Pre-menstrual syndrome	1	0.7

Dizziness	1	0.7
Increased libido	1	0.7
Lighter bleeding / period	1	0.7

Note: The term “period” is used in this Table consistent with the terms used by the respondents, but we acknowledge that many athletes use “period” incorrectly to describe the withdrawal bleed experienced with HC use. Please see main text for further discussion.