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Prevalence of menstrual cycle disturbances and hormonal contraception use in Norwegian women of differing activity levels: a part of the FENDURA project.

Article

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Abstract

Purpose: To investigate the current prevalence of hormonal contraceptive (HC) use and menstrual disturbances (MD) in the Norwegian female population, stratified by physical activity level, sport type, and age category.

Methods: In total, 2,027 Norwegian women answered an online questionnaire that contained questions regarding: demographics, use and type of HC, menstrual cycle function, physical activity volume, type of physical activity undertaken, and competitive athletic status.

Results: There was a 52.1% (n=1056) overall prevalence of HC use reported across the entire group, ranging from a low of 49.5% in competitively active women, to a high of 57.0% for elite athletes. Of the 1,056 women who reported currently using a HC, the majority (62.0%) used progestin-only HC, with combined HC use at 37.9%. Reasons for HC use were varied, but primarily for contraception (67.7%) or other reasons (29.4%). Prevalence of at least one type of MD was found to be 24.7%.

Conclusion: Approximately half (51.2%) of sampled Norwegians currently used some form of HC, which is a higher prevalence than previously reported. Future research using female participants should always ensure the inclusion of HC-using participants, to permit the generalizability of results to a large proportion of the Norwegian population. A quarter (24.7%) of non-HC users reported a MD, a lower rate than previous reported data, however primary amenorrhea was not included in this prevalence.

1 Introduction

Since the release of the first hormonal contraceptive (HC) pill to market in 1960, there has been a major rise in the global prevalence of HC use. For example, a recent 2019 estimate indicated that the percentage of women worldwide, aged 15-49 years, who used HCs was 21.5%. However, this estimate also included non-hormonal (i.e., copper-based) intra uterine devices (IUDs) and did not consider usage of the HC patch or hormonal vaginal ring, so the true global prevalence of HC use is arguably different. When focused more specifically on just Europe and North America, the use of HCs has been estimated to be around 28% (United Nations, 2019).

In the Nordic countries, the use of HC by women aged 14-49 has been reported to be higher than that of mainland Europe, with Denmark reporting 42%, and similar proportions observed in both Sweden (41%) and Finland (40%) (Lindh et al., 2017). In comparison, Norway reported a lower HC prevalence when compared to its neighboring countries in the same study, with approximately a third (~33-35%) of Norwegian women using HCs (Lindh et al., 2017). There has also been an observable rise in the use of HC from 2010 to 2013, increasing from ~38% to ~40%, for both Finland and Denmark, the two countries who have reported the highest HC prevalence. Recent research has indicated that Norway has also followed a similar trend, with the use of HCs increased from 36% in 2006, to 40% in 2018 (Furu et al., 2021).

Use of HC by athletes has been suggested to be higher than that of the general population, with research from Denmark reporting a 57% prevalence of HC use in elite athletes (Oxfeldt et al., 2020). Similarity, national and international-level cross-country and biathlon athletes in Norway have indicated a high HC use of 68% (Engseth et al., 2022). The increased use of HC in elite athletes has also been reported in the United Kingdom where 49.5% of the athletes used HC, compared to only 30% of the general public (Martin et al., 2018). The reasons for HC use by athletes seem to vary, with responses ranging from reducing menstrual-related symptoms (e.g., pain/cramps, heavy bleeding, consistent feeling of discomfort), to predicting and/or changing the menstrual cycle, with three-quarters (76%) of Danish athletes indicating the latter factor as an important reason for using HC (Oxfeldt et al., 2020). As these symptoms/reasons potentially impact athletic training and/or exercise performance, it may explain the reason for an increased HC use in athletes compared to the general population. However, these previous studies have specifically focused on elite athletes (Clarke et al., 2021; Ekenros et al., 2022; Engseth et al., 2022; Martin et al., 2018; Oxfeldt et al., 2020) or have broadly described overall prevalence in the general population (Furu et al., 2021; Lindh et al., 2017), and as such there is

a definitive lack of HC prevalence data for lower-level non-elite athletes and recreationally-active exercisers.

Menstrual disorders affect the normal menstrual cycle in non-HC using women in a variety of different ways, such as physical symptoms of irregular menses, excessive blood loss during menses, and/or the absence of menses (Marshburn & Hurst, 2011; Norsk gynekologisk forening, 2021), to psychological symptoms, such as premenstrual syndrome (PMS) or the more severe premenstrual dysphoric disorder (PMDD) (Hofmeister & Bodden, 2016). While irregular bleeding is common during the initial years following menarche, as well as during perimenopause, studies have also reported a higher prevalence of menstrual disturbances (MD) (i.e., secondary amenorrhea, oligomenorrhea, and anovulatory menstrual cycles) in athletes compared to non-athletes (De Souza et al., 2010; Gudmundsdottir et al., 2014; Ravi et al., 2021). A contradictory study found no difference in MD rates between athletes and controls; however, when athletes were divided into leanness and non-leanness sports, there was a higher prevalence of MD found in leanness-sport athletes, compared to both non-leanness athletes and controls (Torstveit & Sundgot-Borgen, 2005). Unfortunately, the majority of previous MD studies have only considered elite athletes, and as such, the prevalence of MD in non-elite athletes remains equivocal.

Clearly, there is a need to undertake additional research on the prevalence of HC use and MDs in Norway, when stratified by differing levels of physical activity. Therefore, the present study aimed to describe the overall prevalence of HC use, HC type, and MC prevalence, across different ages and athletic categories of Norwegian females, from the sedentary to the elite athlete.

2 Materials and methods

This study was a part of The Female Endurance Athlete (FENDURA) project, led by the School of Sport Sciences at UiT The Arctic University of Norway. The FENDURA project is a collaboration between UiT and NTNU (Norwegian University of Science and Technology), the Norwegian Olympic Committee (Olympiatoppen), the Norwegian Ski Federation, and the Norwegian Biathlon Federation. The main goal of the FENDURA project is to investigate the female-specific aspects of training and performance in female endurance athletes.

2.1 Participants

Data collection for this project was undertaken in two different stages, separated by ~4.5 months, with the total data collection duration from the end of 2021 until the end of 2022. The inclusion criterion for both stage 1 and 2 was 'currently menstruating females residing in Norway' with a minimum age of ≥16 years for stage 1 and ≥12 years for stage 2. Notable exclusion criteria included: 1) missing menarche, or 2) having reached menopause.

The first phase, stage 1, was initiated on 1 December 2021, and was open for responses until late April 2022. As the questionnaire for stage 1 was focused on adults and older teenagers (≥16 years), participant recruitment was primarily undertaken via social media platforms (i.e., Twitter, Facebook, Instagram). Recruitment was also achieved via contact with media communication personnel from relevant organizations and large institutions (e.g., universities), who then disseminated a link to the survey via their own communication channels. A total of 1,688 females participated in Stage 1.

The second phase, stage 2, was initiated 20 September 2022, and was open for responses until 1 January 2023. The focus for stage 2 was the recruitment of younger female participants, aged 12-19 (i.e., Norwegian middle school [12-16 years] and Norwegian high school [15-19 years]), although no upper age limit was set (apart from the exclusion criterion of menopause). An email containing information about the study and the questionnaire was first sent out to administrations in the Norwegian counties and municipalities on 20 September 2022, and was then later sent to all public and private middle- and high schools in Norway, in the period between 20 September 2022 and 4 October 2022. A final reminder was also sent out to all middle- and high schools on 7 November 2022, to ask for additional respondents to consider answering the questionnaire. A total of 428 females participated in stage 2.

For both stages, a total of 2,116 participants responded to the questionnaire, however 89 (4.2%) participants were removed due to missing data or incomplete answers. After data cleaning and categorization of participants into different physical activity levels, a total of n=2027 (95.8%) participants were included in the final analysis. See “Table 1” for descriptive statistics on the anthropometric data stratified by activity levels.

Table *1*

Anthropometric data of participants across different activity levels

Characteristic	Overall n = 2,027	Physical inactive n = 758	Exerciser n = 1,052	Recreational n = 10	Competitive n = 93	Elite n = 114
Age (yrs)	28.7 (9.9)	29.1 (10.2)	29.7 (9.7)	32.1 (8.1)	23.3 (8.4)	21.8 (6.7)
Weight (kg)	68.6 (13.8)	71.0 (16.5)	67.6 (12.2)	61.3 (12.8)	65.9 (8.5)	65.1 (9.9)
Missing (n)	31	18	9	0	2	2
Height (cm)	167.8 (6.4)	167.5 (6.4)	168.0 (6.4)	164.7 (6.4)	168.0 (5.6)	168.8 (6.8)
Missing (n)	5	4	1	0	0	0

Note. Data are presented as mean and standard deviation of sample [Mean (SD)].

2.2 Questionnaire

The data for this study were collected through a custom online questionnaire (hosted by Nettskjema, 2022, Oslo, Norway) that was developed from previous similar survey research in elite female endurance athletes (Engseth et al., 2022). Due to the different aims of the present study (e.g., inclusion of women with differing physical activity levels, such as physically inactive, and/or different sports), the questionnaire was altered from that used by Engseth et al. (2022). Specifically, additional data was collected on participant's competitive level (or lack thereof), primary sport of interest (if any), and severity of menstrual disturbances side-effects. The questionnaire also collected relevant data regarding HC use (i.e., type, brand, hormones, and side effects), information regarding the menstrual cycle for non-HC users (i.e., duration, disturbances, irregularities), and information on their physical activity (i.e., what sport(s), hours of training, competitions, and level of competition).

The questionnaire was designed to take ~15-20 minutes to complete, with a total of 98 questions, divided into 42 close-ended questions, 28 numerical questions, 19 open ended questions, and 9 multiple choice questions. Free text boxes were utilized in some sections of the questionnaire, to ensure that respondents had the opportunity to provide more detailed answers, if their choice was not captured in the closed answer options. However, this qualitative textual data was not further analyzed in the present thesis, due to the limited response rate of these free text responses. The questionnaire was split into six distinct sections, with participants only completing sections that were specifically relevant for their HC-use, or lack thereof. For all participants, demographic data, physical activity and training, and COVID vaccine information was collected. However, HC users only completed sections regarding their current, and historical, HC usage, whilst non-HC users only answered sections regarding their menstrual cycle, and if they had ever used HC previously. More detailed information regarding the questionnaire can be found in the Masters Thesis document (see *Extended Methods*), and a copy of the questionnaire can be viewed in Appendix 1.

2.3 Data analysis

All data analyses were completed using R (R Core Team, 2023) in the RStudio environment (Posit team, 2023). Nominal response variables (i.e., HC use, MD occurrence) were modelled using logistic regression with a logit link function via the binominal family. All regression models included the following variables as fixed factors: *activity level* (nominal with 5 levels:

physically inactive, exerciser, recreational, competitive, elite), *sport group* (nominal with 8 levels: aesthetic, ball games, endurance, high mass, power, technical-weight, technical, weight class), and *age group* (nominal with 8 levels: 13-16, 17-1920-24, 25-29, 30-34, 35-39, 40-44, 45-55). The interaction terms of these fixed factors were: *activity level * sport group*; *activity level * age group;* and, *activity level * sport group * age group*. Post-hoc testing on estimated marginal effects was completed using the 'emmeans' R package (Lenth, 2023) with a Bonferroni correction (Bland & Altman, 1995) for multiple comparisons. Statistical significance was set to $\alpha = 5\%$. Logistic regression data are provided as mean or odds ratio (OR; variance is reported as 95% confidence interval (95% CI). Continuous data are presented as mean (standard deviation; SD) and discrete data are described as frequency (n (%)). Tables were made with the R packages, 'gtsummary' (Sjoberg et al., 2021) and 'flextable' (Gohel, 2023). All figures were made with the package 'ggplot' (Wickham, 2016).

3 Results

Descriptive statistics on the anthropometric data, stratified by activity levels, are presented in "Table 1".

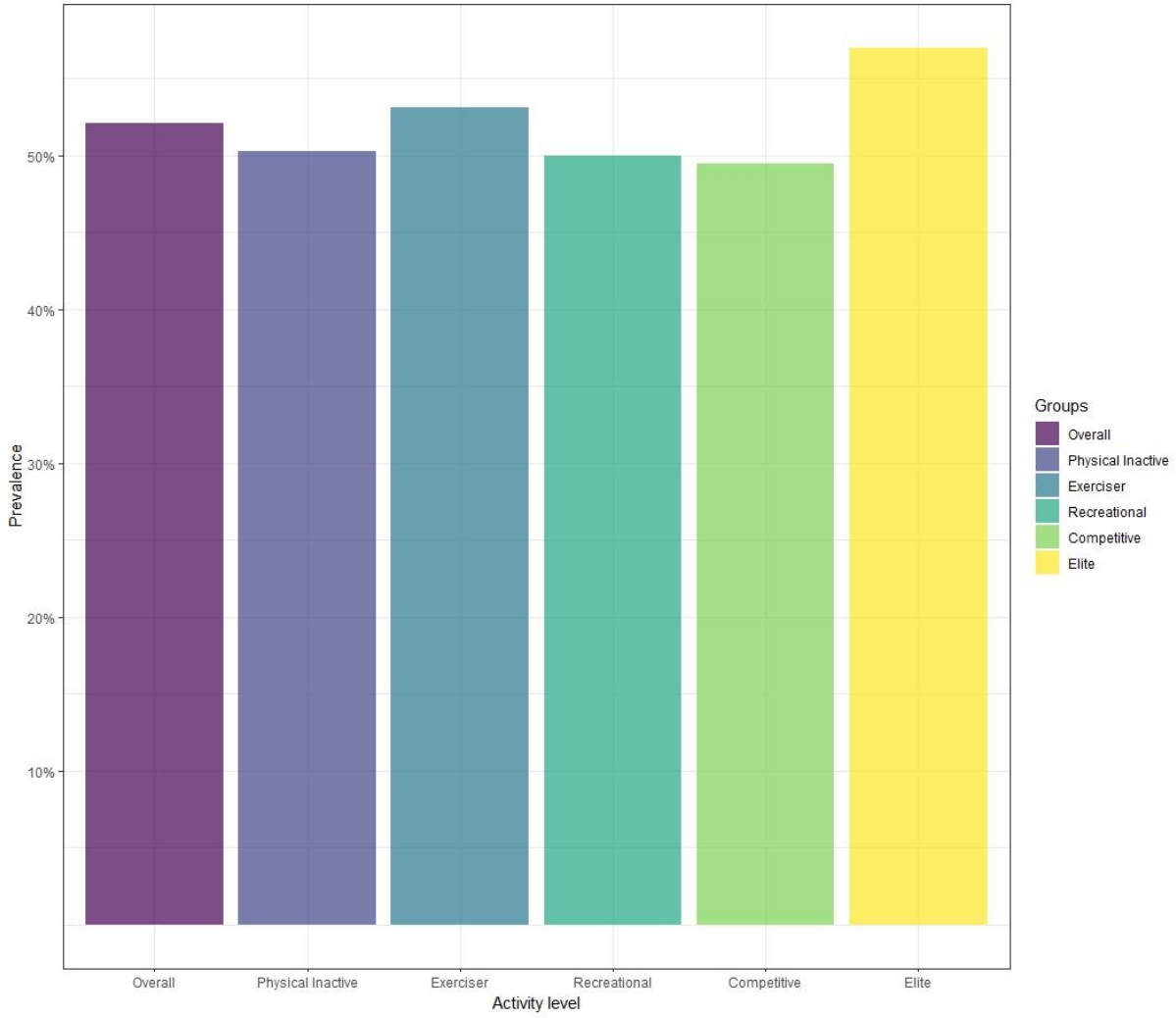
3.1 Prevalence of HC use by different activity levels

Of the total sample of 2,027 participants, 52.1% (n=1056) reported currently using HCs, with 37.9% (n=401) using combined HCs, and 62.0% (n=655) using progestin-only HCs (see Table 2 and Supplementary Table 1). There was no significant main effect for *activity level* (p=.581) on HC use. Interaction between *activity level* and *sport groups* (p=.265) or *age groups* (p=.536) were also included to check for possible variation in the effect of HC use, with no significant results. See Figure 1 for prevalence of HC use across different activity levels.

The reasons for HC use are presented in Supplementary Table 2, where more than two thirds (67.7%) reported the primary reason as 'contraception', while 29.4% answered 'other' (note: 2.8% did not answer). Table 2 shows the prevalence of HC and different delivery methods used across different activity levels.

Figure 1

Prevalence of hormonal contraceptive (HC) use across activity levels.



Note. This figure demonstrates the prevalence of hormonal contraceptive (HC) use across different activity levels. The overall prevalence is presented on the bar furthest to the left. Column color represents different activity level categories, as described by the legend.

Table *2*

Prevalence of hormonal contraceptive (HC) use across different activity levels.

	Overall	**Physical inactive**	**Exerciser**	**Recreational**	**Competitive**	**Elite**
	n = 2,027	n = 758	n = 1,052	n = 10	n = 93	n = 114
HC Use	1,056 (52.1%)	381 (50.3%)	559 (53.1%)	5 (50.0%)	46 (49.5%)	65 (57.0%)
HC Type						
IUD	377 (35.7%)	126 (33.1%)	221 (39.5%)	1 (20.0%)	13 (28.3%)	16 (24.6%)
Implant	141 (13.4%)	55 (14.4%)	68 (12.2%)	0 (0.0%)	7 (15.2%)	11 (16.9%)
Injection	10 (0.9%)	6 (1.6%)	4 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Patch	9 (0.9%)	3 (0.8%)	4 (0.7%)	0 (0.0%)	1 (2.2%)	1 (1.5%)
Pill	492 (46.6%)	180 (47.2%)	247 (44.2%)	4 (80.0%)	24 (52.2%)	37 (56.9%)
Vaginal Ring	27 (2.6%)	11 (2.9%)	15 (2.7%)	0 (0.0%)	1 (2.2%)	0 (0.0%)

Note. Data are presented as frequency and proportion of sample [n (%)]. Note: HC = hormonal contraceptive; IUD = intrauterine device.

3.1.1 Prevalence of HC use in different sport groups

Although there was a significant main effect for different sport groups (p=.028), there were no significant post-hoc differences found between the sport groups. Power sports had the highest prevalence of HC use with 60.1%, and high mass sports the lowest prevalence, at 28.5%. Table 3 shows the prevalence of HC and different delivery methods used across different sports groups.

Table *3*

Prevalence of hormonal contraceptive (HC) use across different sport groups.

	Aesthetic n = 95	**Ballgames** n = 253	**Endurance** n = 477	**High Mass** n = 7	**Power** n = 329	**Technical (Weight)** n = 27	**Technical** n = 63	**Weight Class** n = 24
HC Use	44 (46.3%)	141 (55.7%)	240 (50.3%)	2 (28.5%)	198 (60.1%)	15 (55.5%)	28 (44.4%)	10 (41.6%)
HC Type								
IUD	13 (29.5%)	44 (31.2%)	109 (45.4%)	1 (50.0%)	71 (35.8%)	5 (33.3%)	7 (25.0%)	3 (30.0%)
Implant	8 (18.1%)	22 (15.6%)	25 (10.4%)	0 (0.0%)	25 (12.6%)	0 (0.0%)	4 (14.2%)	2 (20.0%)
Injection	1 (2.3%)	0 (0.0%)	2 (0.8%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Patch	0 (0.0%)	1 (0.7%)	1 (0.4%)	0 (0.0%)	2 (1.0%)	1 (6.7%)	1 (3.6%)	0 (0.0%)
Pill	21 (47.7%)	72 (51.0%)	98 (40.8%)	1 (50.0%)	93 (46.9%)	8 (53.3%)	15 (53.5%)	5 (50.0%)
Vaginal Ring	1 (2.3%)	2 (1.4%)	5 (2.1%)	0 (0.0%)	6 (3.0%)	1 (6.7%)	1 (3.6%)	0 (0.0%)

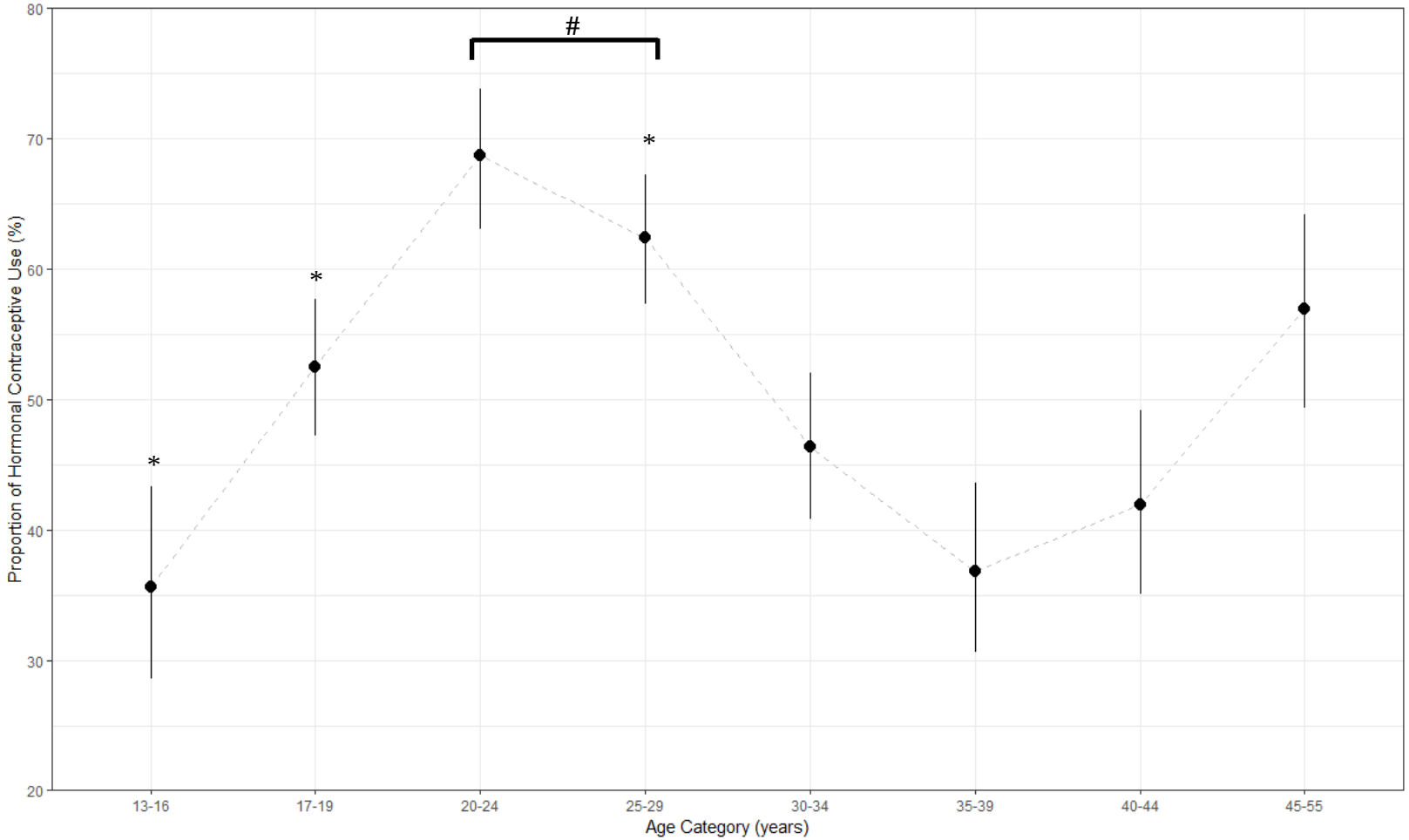
Note. Data are presented as frequency and proportion of sample [n (%)]. Note: HC = hormonal contraceptive; IUD = intrauterine device.

3.1.2 Prevalence of HC use in different age groups

The younger adult groups (i.e., 20-24 and 25-29) reported a higher prevalence of HC use (68.6%, and 62.4%, respectively) compared to the adults in their 30's and early 40's (OR: 1.9 to 3.7; p=0.01 to p<.001; Figure 2). Table 4 shows the prevalence of HC and different delivery methods used across different age groups.

Figure 2

Prevalence of modelled HC usage across age categories.



Note. Dot points represent mean modelled point prevalence, with thin lines representing 95% confidence interval of modelled prevalence data. * indicates significantly different to subsequent age category; # indicates significantly different to 13-16, 30-34, 35-39, and 40-44 age categories. To retain figure clarity, additional comparisons are not shown, rather these can be viewed in Table 4.

Table *4*

Prevalence of hormonal contraceptive (HC) use across different age groups (years).

HC Use	**13-16** α; ε; θ; λ n = 160	**17-19** γ; θ; ξ n = 349	**20-24** β; γ; δ; λ; ξ n = 287	**25-29** β; γ; δ; ξ n = 367	**30-34** ε; θ n = 302	**35-39** α; ε; θ; λ n = 209	**40-44** ε; θ n = 186	**45-55** γ; ξ n = 167
Use HC	57 (35.6%)	183 (52.4%)	197 (68.6%)	229 (62.4%)	140 (46.4%)	77 (36.8%)	78 (41.9%)	95 (56.9%)
Type HC								
IUD	6 (10.5%)	26 (14.2%)	63 (32.0%)	66 (28.8%)	37 (26.4%)	43 (55.8%)	57 (73.1%)	79 (83.2%)
Implant	6 (10.5%)	46 (25.1%)	38 (19.3%)	27 (11.8%)	12 (8.6%)	3 (3.9%)	6 (7.7%)	3 (3.2%)
Injection	0 (0.0%)	2 (1.1%)	0 (0.0%)	3 (1.3%)	1 (0.7%)	0 (0.0%)	1 (1.3%)	3 (3.2%)
Patch	1 (1.8%)	3 (1.6%)	1 (0.5%)	3 (1.3%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Pill	44 (77.2%)	103 (56.3%)	91 (46.2%)	125 (54.6%)	79 (56.4%)	28 (36.4%)	13 (16.7%)	9 (9.5%)
Vaginal Ring	0 (0.0%)	3 (1.6%)	4 (2.0%)	5 (2.2%)	10 (7.1%)	3 (3.9%)	1 (1.3%)	1 (1.1%)

Note. Data are presented as frequency and proportion of sample [n (%)]. Note: HC = hormonal contraceptive; IUD = intrauterine device. Statistically significant differences are indicated by the following symbols: α = different to 45-55 years; β = different to 40-44 years; γ = different to 35-39 years; δ = different to 30-34 years; ε = different to 25-29 years; θ = different to 20-24 years; λ = different to 17-19 years; ξ = different to 13-16 years.

3.1.3 Prevalence of menstrual disturbances in different activity levels

The overall prevalence of menstrual disturbances was 24.7% in non-HC users (occurrence of at least one MD, because individuals could have multiple different MDs, but we are only counting per person). The highest prevalence of amenorrhea (6.1%), oligomenorrhea (18.4%), polymenorrhea (4.1%) and menorrhagia (16.7%) were found in elite athletes, and the highest prevalence of metrorrhagia were found in physically inactive participants (9.3%).

There was no significant main effect on activity level on amenorrhea (p=.793), oligomenorrhea, (p=.068), polymenorrhea (p=.483), or metrorrhagia (p=.256). Although there was a significant main effect for different activity levels on menorrhagia (p=.025), there were no significant post-hoc differences between the levels. Interaction between activity levels, sport groups (p=1.00) and age groups (p=1.00) were included to check for possible variation in the effect of HC use, with no significant findings. Table 5 shows the prevalence of the different MDs by non-HC users overall and across different activity levels.

Table *5*

Prevalence of menstrual disturbances in non-hormonal contraceptive users overall and across different activity levels.

Menstrual disturbance (Non-HC users)	Overall n = 971	Activity Level				
		Physical inactive n = 377	Exerciser n = 493	Recreational n = 5	Competitive n = 47	Elite n = 49
Amenorrhea	34 (3.5%)	11 (2.9%)	18 (3.7%)	0 (0.0%)	2 (4.3%)	3 (6.1%)
Oligomenorrhea	105 (10.8%)	50 (13.3%)	41 (8.3%)	1 (20.0%)	4 (8.5%)	9 (18.4%)
Polymenorrhea	24 (2.5%)	11 (2.9%)	11 (2.2%)	0 (0.0%)	0 (0.0%)	2 (4.1%)
Menorrhagia	102 (10.8%)	45 (12.3%)	46 (9.6%)	2 (40.0%)	1 (2.2%)	8 (16.7%)
Metrorrhagia	70 (7.2%)	35 (9.3%)	29 (5.9%)	0 (0.0%)	4 (8.5%)	2 (4.1%)

Note. Data are presented as frequency and proportion of sample [n (%)].

3.1.4 Prevalence of menstrual disturbances in different sport groups

There was no significant main effect on sport group on amenorrhea (p=.681), oligomenorrhea, (p=.299), polymenorrhea (p=.585), menorrhagia (p=.439), and metrorrhagia (p=.116). Table 6 shows the prevalence of the different MDs by non-HC users across different sport groups.

Table *6*

Prevalence of menstrual disturbances in non-hormonal contraceptive users across different sport groups.

Menstrual disturbance (Non-HC users)	Sport Group							
	Aesthetic n = 51	**Ballgames** n = 112	**Endurance** n = 237	**High Mass** n = 5	**Power** n = 131	**Technical (Weight)** n = 12	**Technical** n = 35	**Weight Class** n = 14
Amenorrhea	1 (2.0%)	4 (3.6%)	13 (5.5%)	0 (0.0%)	3 (2.3%)	1 (8.3%)	1 (2.9%)	1 (7.1%)
Oligomenorrhea	7 (13.7%)	14 (12.5%)	16 (6.8%)	0 (0.0%)	12 (9.2%)	2 (16.7%)	3 (8.6%)	2 (14.3%)
Polymenorrhea	1 (2.0%)	4 (3.6%)	3 (1.3%)	0 (0.0%)	4 (3.1%)	1 (8.3%)	0 (0.0%)	0 (0.0%)
Menorrhagia	3 (6.5%)	11 (10.2%)	26 (11.0%)	2 (40.0%)	9 (7.0%)	2 (18.2%)	3 (8.6%)	1 (7.1%)
Metrorrhagia	2 (3.9%)	11 (9.8%)	10 (4.2%)	0 (0.0%)	7 (5.3%)	2 (16.7%)	1 (2.9%)	2 (14.3%)

Note. Data are presented as frequency and proportion of sample [n (%)].

3.1.5 Prevalence of menstrual disturbances in different age groups

There was no significant main effect for age groups on polymenorrhea (p=.094) or metrorrhagia (p=.730). Although there was a significant main effect for age groups on amenorrhea (p=.013), oligomenorrhea (p=.007) and menorrhagia (p=.008), there were no significant post-hoc differences between the levels. Table 7 shows the prevalence of the different MDs by non-HC users across different age groups.

Table *7*

Prevalence of menstrual disturbances in non-HC users across different age groups.

Menstrual disturbance (Non-HC users)	Age Category (years)							
	13-16	**17-19**	**20-24**	**25-29**	**30-34**	**35-39**	**40-44**	**45-55**
	n = 103	n = 166	n = 90	n = 138	n = 162	n = 132	n = 108	n = 72
Amenorrhea	5 (4.9%)	10 (6.0%)	5 (5.6%)	7 (5.1%)	4 (2.5%)	1 (0.8%)	0 (0%)	2 (2.8%)
Oligomenorrhea	15 (14.6%)	26 (15.7%)	12 (13.3%)	19 (13.8%)	11 (6.8%)	5 (3.8%)	9 (8.3%)	8 (11.1%)
Polymenorrhea	4 (3.9%)	6 (3.6%)	4 (4.4%)	3 (2.2%)	1 (0.6%)	3 (2.3%)	0 (0%)	3 (4.2%)
Menorrhagia	7 (7.1%)	11 (7.6%)	10 (11.1%)	12 (8.7%)	14 (8.6%)	13 (9.8%)	17 (15.7%)	18 (25.0%)
Metrorrhagia	9 (8.7%)	14 (8.4%)	8 (8.9%)	11 (8.0%)	12 (7.4%)	5 (3.8%)	6 (5.6%)	5 (6.9%)

Note. Data are presented as frequency and proportion of sample [n (%)].

3.2 Discussion

The aim of this study was to investigate and describe the current prevalence of HC use and MD occurrence in Norwegian females, stratified by activity level (from physical inactive to elite athletes), sport type, and age category. The main findings were: 1) approximately half (52.1%) of all participants reported currently using HCs; 2) the highest HC use was found in elite athletes (57.0%) whilst the lowest was in competitive athletes (49.5%); and 3) one quarter (24.7%) of non-HC users reported a MD, with elite athletes reporting the highest prevalence of amenorrhea, oligomenorrhea, polymenorrhea, and menorrhagia.

3.2.1 Prevalence of HC use

The overall prevalence of HC in the present study was found to be 52.1%, which is considerably higher than the ~32-40% prevalence described in previous studies that have focused on the general Norwegian population (Furu et al., 2021; Lindh et al., 2017). However, as the most recent Norwegian prevalence data was collected more than four years ago (circa 2018, Furu et al, 2021), and the longitudinal data from these studies has indicated a trending increase of HC use over time, it stands to reason that HC usage in 2022 would have also increased above the previous prevalence of 40% from 2018 (Furu et al., 2021; Lindh et al., 2017). Regardless, this relatively high HC prevalence is an interesting finding, and although there were no statistically significant differences between activity levels and sport groups, there may be other confounders that might have influenced the results, such as socioeconomic status, ethnicity, and team- or sport-specific phenomena.

The difference in data collection methods might also explain the difference in results compared to previous studies, as the data used by Lindh et al. (2017) and Furu et al. (2021) were taken from national prescription databases and manufacturers. In comparison, the data in this study is self-reported by participants who voluntarily participated, which might result in a selection bias, where the study participants do not truly represent the population. However, the relatively large sample size (n = 2,027) of this study should have provided an accurate representation of the true population, with the exception for younger females in Oslo (12-19 years), where potentially not enough data was collected (n=12; Supplementary Table 3). Notably, Furu et al. (2021) also reported the lowest prevalence of HC use for age groups and locations was Oslo-based 16 to 19 year-olds, with the authors suggesting this issue may have been due to the higher proportion of people with an immigrant-background. Such a hypothesis may potentially explain the low response rate in this location and age group for the present study, as the sociocultural

values that result in lower HC usage in Oslo teenagers may also inhibit their interest in participating in a self-report questionnaire about menstrual cycle (dys)function and/or HC usage. Thus, the HC prevalence results of the present study can be considered generalizable across Norway, with caveat of teenagers in Oslo.

Although there was no statistical significance between the physical activity level groups in the present study, a simple point prevalence comparison to Engseth et al. (2022) shows considerable differences. For example, the 57.0% prevalence for elite athletes (Table 1) is similar to two recent studies in both Norway (56.0%) and Denmark (57.0%) (Oxfeldt et al., 2020; Solli et al., 2020). However, this prevalence is still notably lower than the ~68% reported by Engseth et al. (2022) in a recent study on Norwegian elite female biathletes and cross-country skiers. Therefore, the range in the proportion of HC usage by elite athletes appears to be relatively wide, between 42% to 68%.

There are likely numerous factors that determine or influence the usage of HC by athletes, one of which may be type of sport, e.g., team-based ball-sport athletes, compared to individual endurance athletes. The current study had a range of sports represented, comparable to the majority of previous studies who also reported similar HC prevalence rates (Armour et al. (2020); Cheng et al. (2021); Ekenros et al. (2022); Martin et al. (2018); Oxfeldt et al. (2020)). However, this is in contrast with both Engseth et al. (2022); Solli et al. (2020) who only focused their investigation on Norwegian cross-country skiers and biathletes. Therefore, this might imply some sport specific cultural phenomena, however it does not explain the difference in HC usage between studies that have considered the same type of athletes (e.g., Engseth et al., (2022) compared to Solli et al. (2020)).

One possible reason for this discrepancy in athletic HC prevalence may be the lack of a formal framework for defining different activity levels and as such, there seems to be a broad definition of the term ‘elite athlete’, making it challenging to compare and contrast results between previous studies. In the present study, we have used McKinney et al. (2019) definitions, with the hope that this provide a clearer and more easily replicated physical activity categorization, allowing for improved comparison to future female HC prevalence research. However, it should be noted the even with this framework, we were unable to verify that our elite and competitive athletes were indeed *actually* elite or competitive athletes, due to the definition used in the framework and missing data about what type of competitions the athletes were performing.

The majority of participants stated that the reason for HC use was contraception (67.7%, Supplementary Table 2), which is higher than the 40.3% reported by Engseth et al. (2022), while similar to McNamara et al. (2022). Notably, thought participants in the later study of McNamara et al. (2022) had the ability to select multiple responses to this question (e.g., 71% contraception, 61% timing and/or predictability). There seems to be various reasons for using HC across studies, and it could be that, if given the option, participants in the current study would have also chosen multiple reasons for HC use. When these participants were asked if, or why, they skipped their periods (i.e., did not use the 'placebo' pills and so avoided the withdrawal bleeding), reasons similar to previous studies on athletes were stated (translated from Norwegian):

- "…if you want to avoid menstruation on holiday." F24 – *Physically inactive*.
- "To avoid menstruation on e.g., vacation, adapting partner's work schedule - adapting menstruation to my life, instead of always having to adapt to menstruation." F33 – *Exerciser*.
- "I work in the army. I skip my period when on military exercise." F24 – *Exerciser*.

While the age group from 20-24 years presented the same rates of HC usage as earlier studies with 68.6% (Furu et al., 2021), the 62.4% prevalence found for 25-29 year olds was seemingly higher than previous research; although poor data availability in this previous study hindered our ability to directly compare the prevalence rates. As highly competitive and elite level athletes are overrepresented in the younger age groups (i.e., between 13 to 30 years), the higher rate of HC usage by athletes could potentially explain the higher prevalence observed in these age groups. However, the present study found no statistically significant interaction effects between HC use, activity level, and age groups; although this might be due to the lack of statistical power, arising from the limited sample sizes that occurred when dividing the groups into small categories.

Another speculative reason for the observed higher rates of HC usage by younger adults may be due to an increased ease-of-accessing HC information, using their phones and/or computers at any given time, and therefore lead to improved HC knowledge and higher likelihood of selecting to use a HC. Alternatively, younger Norwegian women in their early 20's may focus on the completion of tertiary education and/or early career development, and thus chose HCs for contraceptive. As the average age of first-time mothers in Norway is 30.1 years, it is likely that women in their late 20's and 30's may have a change in their priorities and consider

stopping the use of HCs in order to achieve pregnancy. Other factors that might explain the different rates of HC usage across the age categories could be socioeconomic status and/or ethnicity. Although these factors were not considered in the present study, research on the socioeconomic factors in Tromsø-based women, aged 40-49 years, did not find any statistical significant difference in HC use by socioeconomic status (Bjørkås & Skjeldestad, 2023), with the authors reporting a HC usage prevalence (~50%) similar to that of the current study (46.7% using the same age span).

3.2.2 Prevalence of MD

Nearly one quarter (24.7%) of non-HC participants reported at least one current MD (note: an individual could report multiple simultaneous MDs, but was considered a dichotomous response of MD occurrence per person). Similar to previous studies, the prevalence of amenorrhea (6.1%) and oligomenorrhea (18.4%) were found to be higher in elite athletes than other groups. The overall prevalence of oligomenorrhea in the current study, 10.8%, was higher than the 3-4% reported by (Wilkosz et al., 2021). However, overall MD prevalence data was found to be 24.7%; much lower than the results from Oxfeldt et al. (2020), where a ~50% prevalence was reported. Arguably our finding – that a quarter of respondents reported a MD – is more in line with the 15.2-16.5% prevalence reported by Torstveit and Sundgot-Borgen (2005). Likewise, rates of secondary amenorrhea (3.5%) and polymenorrhea (2.5%) were similar to the 3-4% prevalence of secondary amenorrhea reported from (Wilkosz et al., 2021) and the 2.5-3.0% prevalence of polymenorrhea in adolescent Italian females (De Sanctis et al., 2014; Rigon et al., 2012). The rates of menorrhagia and metrorrhagia, 15-20%, were much lower than the numbers reported by Eraker and Holstad (2021), except for the age groups 40-44 and 45-55, who has a prevalence of menorrhagia of 16% and 25%, respectively. Female athletes who undertake a high training volume and have insufficient energy intake are potentially at higher risk of developing MD(s) due to factors related to relative energy deficiency in sport (RED-s) (Ackerman et al., 2019; Mountjoy et al., 2018). This syndrome, RED-s, is well-known to negatively impair menstrual function, evident in the ~50% MD prevalence found by Oxfeldt et al. (2020), however the current study did not have a similar finding. However, the current study did use MD definitions from Norsk gynekologisk forening (2021), which may differ considerably from the definitions used in previous studies. This potential issue was highlighted by De Souza et al. (2010), and as stated in the same study, such

discrepancies need to be taken into account when comparing results from different studies, in combination of the different populations of athletes.

3.3 Limitations

All research has certain limitations and caveats, and this study is not without such issues. For example, the questionnaire used in this study was relatively long and comprehensive, potentially reducing the engagement and interest of respondents to accurate read and complete all sections correctly. When undertaking the statistical analysis, some of the sub-groups had small sample sizes and thus low statistical power, indicating the possible occurrence of type-2 errors. Primary amenorrhea was excluded from the study, due to menarche as an inclusion criterion of participation in this study, however primary amenorrhea should have been included to get the true MD prevalence.

3.4 Future research

Further research should examine if there are any factors affecting the HC prevalence collecting data on additional factors such as socioeconomical status, ethnicity, and rurality. Additional studies should also explore HC prevalence in different sports and/or teams, to confirm or reject the hypothesis that there may be a sport or team-specific cultural phenomena regarding HC use. Primary amenorrhea should also be included in future surveys, to provide more inclusive and accurate data of the MD prevalence. Research should also aim to recruit more females in the 12 to 15 years age group, in order to gain a more comprehensive and accurate understanding of the total currently menstruating female population in Norway, as opposed to only focusing on the 'adult' population (i.e., ≥18 years old).

3.5 Conclusion

This study provided important, cross-sectional data on the current HC use in Norway, stratified in different activity levels, sport groups and age groups. While there were no statistically significant differences in HC use across the different activity levels or different sport groups, there was a significant age difference in the prevalence of HC usage, with higher rates of use by young adults, when compared to women in their 30's to early 40's. The overall prevalence

of HC was found to be 52.1% which is considerably higher than previous studies in the Norwegian female population. The overall current prevalence of menstrual disturbances in non-HC users was found to be 24.7%, and there were no statistically significant differences between menstrual disturbances across the different activity levels, sport groups and age groups. However, MD prevalence is lower than earlier reported numbers both in the general female population and in elite athletes.

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