

1 **Physical activity and the menstrual cycle: A mixed-methods study of**
2 **women's experiences.**

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18 **Physical activity and the menstrual cycle: A mixed-methods study of**
19 **women's experiences.**

20 The menstrual cycle is an important biological process in women that is
21 associated with a range of physical symptoms, which can shape how women
22 think, feel, and participate in activities of daily life. This study employed a
23 mixed-methods design to investigate adult women's physical activity throughout
24 the menstrual cycle. One hundred and twenty-eight participants completed online
25 questionnaires that explored events of the menstrual cycle (e.g., bleeding, pain,
26 fatigue) and physical activity. Semi-structured interviews with 21 questionnaire
27 respondents unpacked individual experiences of physical activity throughout the
28 menstrual cycle. From the questionnaire data, 44 participants were categorised as
29 avoiders and 84 as non-avoiders of physical activity due to menstrual events.
30 Avoiders of physical activity reported longer periods, heavier menstrual flow,
31 higher levels of fatigue and pain compared to non-avoiders. Interviews revealed
32 that avoidance of physical activity ranged from complete avoidance to adaptation
33 (e.g., types of exercise). Reasons for avoidance and adaptation of physical
34 activity included menstrual symptoms, personal thoughts, and concerns about
35 other people's views of the period. The present study findings emphasise the
36 importance of recognising women's individual perspectives and established
37 societal norms in addition to physical symptoms in order to better understand and
38 normalise physical activity throughout the menstrual cycle.

39 Keywords: menstruation; period; questionnaire; interview; symptoms; avoidance;
40 self

41 **Introduction**

42 The menstrual cycle is a natural process in women's reproductive years that represents a
43 highly individual and personal experience (Brantelid et al., 2014). The start of every
44 menstrual cycle is marked by the period, also known as menstruation, which can lead to
45 symptoms, such as bleeding (Santer et al., 2007, 2008), pain (Chen & Hu, 2019), mood
46 changes (Samy et al., 2019), lethargy and fatigue (Bruinvels et al., 2016). The
47 symptoms can extend beyond the period and throughout the entire menstrual cycle and
48 affect how women feel and think about their bodies (Chrisler et al., 2015; Spadaro et al.,
49 2018). How women feel, think, and act is framed further by normative expectations,
50 stereotypes, and myths about the menstrual cycle (Kowalski & Chapple, 2000; Marván
51 et al., 2006). A combination of menstrual symptoms, women's thoughts and feelings,
52 and social norms could contribute to changes in activities of daily life (Brantelid et al.,
53 2014; Chen et al., 2016; Houston et al., 2006).

54 The most commonly reported menstrual symptoms represent painful cramps
55 (dysmenorrhea) and tiredness (Schoep et al., 2019), as well as heavy bleeding
56 (Bruinvels et al., 2016). On days of the period, the burden of these symptoms has been
57 shown to prevent women from participating in daily activities (Schoep et al., 2019). For
58 instance, 43% of adolescent women avoided aspects of daily life due to menstrual
59 events (e.g., bleeding and pain) of which 21% missed at least one in 30 school days
60 (Houston et al., 2006). Similarly, 64% of adult women missed an average of 2.6
61 workdays per month due to severe menstrual bleeding and pain (Fourquet et al., 2010).
62 Aside from the severity of menstrual symptoms, women's behaviour changes could be
63 shaped by upbringing (Marván & Molina-Abolnik, 2012), education (Stubbs, 2008), and
64 media coverage (e.g., advertisements) (Spadaro et al., 2018). Presentations of the period
65 as a matter of secrecy led women to be vigilant, self-conscious, and selective of daily

66 activities they undertook and avoided (Johnston-Robledo & Chrisler, 2013). Beyond
67 daily activities, however, limited studies have investigated how women experienced and
68 perceived the menstrual cycle and its impact on sporting performance (Findlay et al.,
69 2020; Moreno-Black & Vallianatos, 2005). A study conducted by Moreno-Black and
70 Vallianatos (2005) with first-year students, who had a history of sport participation,
71 found that women associated menstruation with shame and therefore disguised any
72 associated signs (e.g., sanitary product). The participants were concerned and anxious
73 about the visibility of menstruation (e.g., through leakage) and subsequent, negative
74 public attention. Such negative connotations were perpetuated by comments from
75 parents, teammates, and coaches of young women (Moreno-Black & Vallianatos, 2005).
76 Similarly, Findlay et al.'s (2020) study with international rugby players demonstrated
77 that athletes were highly aware and, at times, worried about the impact of their
78 menstrual symptoms on performance. Although severe symptoms, such as
79 dysmenorrhea, limited the participants during strenuous exercise (e.g., high intensity
80 training), the athletes had established coping strategies (e.g., by accepting their
81 menstrual experience or adapting to it), they had sought advice from medical
82 professionals to manage menstrual symptoms, and spoke to trusted others to process
83 their experiences of the menstrual cycle (Findlay et al., 2020). There remains no
84 comparison, however, how physical activity in a non-athlete population might be
85 affected by not only menstrual symptoms, but also women's individual experiences and
86 social understandings of the menstrual cycle.

87 Identifying that there is no extent data on the menstrual impact of physical
88 activity, broader comparisons could be made with examples from the effect of
89 pregnancy, adult life transitions, and body awareness on physical activity. In physically
90 active women, who adapted routines throughout pregnancy, decisions whether to

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91 participate in physical activity and, if so, to which extent, depended on the nature and
92 severity of pregnancy-related symptoms (e.g., nausea, fatigue, backache), as well as
93 women's perceptions of their own pregnancy and social expectations regarding physical
94 activity throughout pregnancy (Cioffi et al., 2010). Women self-managed the type,
95 intensity, and amount of physical activity they undertook, thoroughly evaluating
96 societal expectations, information received from health professionals, and myths that
97 relatives and friends shared with them (Cioffi et al., 2010). Similarly, a survey with
98 14,779 women aged 18–23 years showed that marriage and motherhood, both
99 significant transitions in adult life, put pressure on the time available for physical
100 activity and led to an increase in inactivity (Brown & Trost, 2003). Comparably, body
101 consciousness and the awareness of social norms regarding a desirable body image led
102 women to avoid physical activity (Markland, 2009). The perceived pressure to look a
103 certain way and comparisons to other women in physical activity settings reduced
104 already deflated levels of body satisfaction and affected drop out from physical activity
105 (Pridgeon & Grogan, 2012). This drop out is concerning as it has been shown that
106 physical activity could have a positive effect on dysmenorrhea (Dehnavi et al., 2018)
107 and self-esteem (Zamani Sani et al., 2016).

108 Within the United Kingdom (UK), 15% fewer women than men aged 16-34
109 meet aerobic exercise guidelines and 47% of young adult women undertake no
110 structured exercise compared to 32% of men (NHS Digital, 2017). Barriers to physical
111 activity are multifactorial and the lower level of daily physical activity in women could
112 be attributed to numerous factors. It is however impossible to discount that the
113 menstrual cycle, known to influence other aspects of daily life (e.g., school [Houston et
114 al., 2006], work attendance [Fourquet et al., 2010]), may account in part for lower
115 physical activity in women compared to men. One approach to determining whether

116 physical activity is impacted by the menstrual cycle is to combine quantitative and
117 qualitative methodology and facilitate a holistic understanding of the quantifiable (e.g.,
118 pain and flow) and the personal (e.g., experiences and perceptions) (Santer et al., 2007;
119 2008). Within the context of limited qualitative studies in athletic populations (Findlay
120 et al., 2020; Moreno-Black & Vallianatos, 2005), there remains no broader analysis of
121 physical activity and the menstrual cycle in the general population. The aim of this
122 study was therefore to, (1) quantify events of the menstrual cycle and self-reported
123 physical activity avoidance in women and (2) understand women's lived experiences of
124 physical activity throughout the menstrual cycle. The use of mixed methodology was
125 envisaged to aid an in-depth understanding of the multi-faceted factors affecting
126 physical activity throughout the menstrual cycle, which could usefully inform physical
127 activity recommendations and agendas. We hypothesise based on the avoidance of
128 school (Houston et al., 2006), work (Fourquet et al., 2010) and elite athlete training
129 commitments (Findlay et al., 2020), that women in the present study will show
130 avoidance of physical activity as a result of menstrual events.

131

132 **Methodology**

133 *Design*

134 The authors utilised a mixed-methods design for the purpose of which they adopted a
135 pragmatic research positioning in line with Morgan (2007). Within this view, emphasis
136 is on (1) drawing on the strengths of quantitative and qualitative methods, (2) following
137 an abductive research process, and (3) acknowledging intersubjectivity. In the present
138 study, quantitative research methods were utilised to quantify the extent to which
139 women experienced menstrual symptoms and participated in physical activity while the

140 use of qualitative research methods gave insight into the different ways in which
141 individual experiences of the menstrual cycle affected women's physical activity. By
142 working back and forth between quantitative and qualitative components of this study,
143 the authors followed an abductive research process in line with Morgan (2007). Finally,
144 equal value was placed on the worldviews of the research team members, who
145 recognised and accepted that their individual interpretations about "one world" might
146 differ (Morgan, 2007). In doing so, the authors sought to aid the development of the
147 research (Sandelowski, 2000) and the comprehensiveness of the study findings
148 (O'Cathain, 2010).

149 A questionnaire was developed to examine the frequency and extent of
150 menstrual events as well as self-reported physical activity throughout the menstrual
151 cycle. Semi-structured interviews explored in-depth women's individual experiences
152 and meanings of physical activity and the menstrual cycle (Creswell et al., 2010).
153 Figure 1 visualises how the quantitative and qualitative components were prepared,
154 utilised, and integrated.

155 To ensure research quality, the researchers employed traditional and alternative
156 criteria (Bryman et al., 2008) and aligned their thinking with the integrative framework
157 by Tashakkori and Teddlie (2008). For design quality, focus was on the suitability and
158 adequacy of research design and methods, on whether the study components flowed in a
159 sound manner, and whether the strategies for data analysis were appropriate to meet the
160 research aims. To achieve interpretive rigor, it was of importance to engage in critical
161 debate and to seek interpretive agreement in the research team, to ensure distinctiveness
162 of interpretations, and adequate integration of quantitative and qualitative results.
163 Finally, the transferability of quantitative and qualitative results into other contexts and

164 participant groups was prioritised over rigid emphasis on generalisability or context-
165 dependence of the study results (see discussion).

166

167 Insert figure 1 here.

168

169 ***Participants***

170 Following ethical approval from the Institution Review Board, participant recruitment
171 took place via social media (Twitter and Facebook) and leaflets, which were distributed
172 at fitness centres affiliated to the authors' universities by the research team. The authors
173 sought to gain a broad understanding of physical activity and the menstrual cycle from
174 women in the generic population, however, equally adopted a purposeful recruitment
175 strategy, as only women of menstruating age were eligible for participation (Collins,
176 2010). This approach proved successful as patterns were later observed in the data
177 gathered from the study participants. The recruitment process led to a sample of 128
178 women of multiple races and ethnicities (27.9 (7.5) years, 1.65 (0.06) m, 63.2 (12.2) Kg,
179 Table 1), who completed the online questionnaire. Through the questionnaire, 82 of 128
180 participants provided consent to be contacted for further research participation and of
181 these, 38 shared their contact information (email address).

182 The 38 questionnaire respondents, who had provided contact details, were then
183 invited to a follow-up interview and 21 women took part in interviews. All of whom
184 completed the online questionnaire first and then participated in an interview. Interview
185 invitations and interviews themselves were led by the principal author, one of the
186 female researchers on the team, to facilitate the establishment of rapport and trust

187 (Miller, 2017), which was considered important to intimate discussions about the
188 menstrual cycle (Dempsey et al., 2016). Interviews were conducted at times and
189 locations that were not only convenient, but also facilitated comfort between her and the
190 participants. Everyone, who stepped forward for an interview, was interviewed and as
191 the final interviews were arranged, saturation had been reached and the research team
192 were confident to halt data collection (Beitin, 2012).

193

194 ***Data collection***

195 *Questionnaire*

196 For the purpose of this research, participants completed a questionnaire about their
197 menstrual cycle duration, menstrual flow, pain or discomfort, and lethargy, combined
198 with questions related to exercise avoidance and self-reported physical activity status.
199 All aspects of the questionnaire were completed online (Jisc, UK). Informed consent
200 was obtained via a compulsory drop down selection at the start of the questionnaire,
201 which was presented following a participant information page. Those who responded to
202 “I do not provide consent for my answers to be used in research” were directed to an
203 exit page of the questionnaire. All questions required a compulsory answer, however
204 two participants selected “not applicable” for their self-reported body mass, which is
205 therefore presented from N = 126. The questionnaire was developed adopting aspects of
206 previous studies that had reported menstrual symptoms, including items from the
207 Menstrual Bleeding Questionnaire (3 items, Matteson et al., 2015), assessment of
208 menstrual pain (1 item, Larroy, 2002), and menstrual flow heaviness (1 item, Fraser et
209 al., 2015).

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210

211 Participant demographics

212 Participants completed drop-down selections for age (yrs), height and body mass.

213 Options were given for the height in metres and feet and inches, and for body mass in

214 kg and lbs.

215

216 Hormonal contraceptive

217 Participants were given the option of seven choices related to their use of hormonal

218 contraceptive, from “none” to different forms of hormonal contraceptives, such as oral

219 contraceptive pill (including type and exogenous hormone dosage), patch, injection, or

220 intrauterine devices. For the purpose of data analysis, they are classified as: “None” if

221 they use no form of hormonal contraceptive, “Pill” if they use any form of oral

222 contraceptive, and “non-oral contraceptive” if they use any form of indwelling, injected

223 or cutaneous hormonal contraceptive.

224

225 Menstrual events

226 Participants were asked “Over the last three months, roughly how many days on

227 average has your period lasted?”; these data are reported in the present results as “length

228 of period”. In addition, participants completed a calendar style grid for the symptoms

229 experienced throughout the month for: “bleeding”, “spotting”, “discomfort, cramps or

230 pain” and “lethargy and fatigue”. Within the questionnaire, each of these menstrual

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231 symptoms contained a more detailed description. Participants were instructed to select
232 the days of the month when these symptoms normally occur, with specific reference to
233 the previous month. The frequency of each symptom was summed throughout the
234 month and is presented below as the number of days each symptom occurs during a
235 menstrual cycle (days/MC). Although reliability data is available on retrospective recall
236 for some elements of the menstrual cycle, for instance 80% of women are able to recall
237 their last period date with two days of accuracy (Wegienaka & Baird, 2005) and
238 menstrual cycle length is underestimated by one day compared to using prospective
239 logging (29.4 and 30.9 days, respectively [Small et al., 2007]), the reliability of
240 recalling period length as described above is not presently reported. There is however,
241 “excellent agreement” between daily compared to 1-month recall for menstrual
242 symptoms of bleeding heaviness and pain (Matteson et al., 2015), with the risk of recall
243 bias on these specific elements of the Menstrual Bleeding Questionnaire being
244 described by those authors as “not a problem”. It should also be noted that 52% of our
245 participants self-reported that they tracked their menstrual and pre-menstrual events
246 through an App or diary, and 88% reported that they were somewhat or very confident
247 that they “can accurately recall [their] menstrual cycle dates and pre-menstrual
248 symptoms”.

249

250 Heavy or normal menstrual bleeding

251 Participants were classified as “heavy” menstrual bleeders based on the selection of two
252 or more of the following symptoms, consistent with Fraser et al. (2015): 1) a need for
253 double sanitary products (e.g., tampons and towels) at the same time, 2) a need for
254 frequent changes of sanitary towels or tampons (every two hours or less, or 12 sanitary

255 items per day), 3) bleeding through sanitary products onto clothes or bedding, and 4) the
256 presence of large clots within period blood. A final option of “none of the above” was
257 also included. Participants reporting one or none of the above symptoms were classified
258 as “normal” menstrual bleeders (Fraser et al., 2015). These terminologies are consistent
259 with the International Federation of Gynecology and Obstetrics (FIGO) systems for
260 nomenclature of symptoms of normal and abnormal uterine bleeding (Fraser et al.,
261 2011). Despite the accepted terminology and classification of heavy menstrual bleeding,
262 there is presently no reliability data available for the classification of “heavy menstrual
263 bleeding” as established by Fraser et al. (2015). Concurrent validity has however been
264 previously reported based on menstrual symptom severity being higher in women who
265 are classified as experiencing heavy compared to normal menstrual bleeding (Matteson
266 et al., 2015), with daily and monthly flow scores showing excellent agreement ($\rho =$
267 0.82, Matteson et al., 2015).

268

269 Pain

270 Participants were provided with a numerical scale from 0-10 (Larroy, 2002), where 0
271 was labelled “no pain”, 5 was labelled “moderate pain” and 10 was labelled “worst
272 possible pain”. Within the questionnaire, a visual analogue scale was also provided
273 under “more info”. Participants were classified into “mild pain” if pain was between 1
274 and 3, “moderate pain” between 4 and 7 points, and “severe pain” between 8 and 10
275 points (Kural et al., 2015). Due to there being insufficient “avoider” participants (see
276 below) falling within the “no pain” category, the “no-pain” and “mild pain” were
277 compressed into a “no-to-mild pain” category representing all participants reporting
278 pain of ≤ 3 . Analysis of menstrual pain was conducted based on both continuous data

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279 from the numerical scale (termed pain severity, Table 1), and pain classification.

280

281 Avoidance

282 Participants were asked “In the last 3 months, which, if any, of the following activities
283 have you avoided or postponed due to menstrual events or discomfort?” with the
284 options provided of “social activities”, “work or university”, “playing sport, going to the
285 gym, or other physical activities” and “none”. An open text option of “other” was also
286 provided. Where these included recreational activities such as “swimming”, “walking”
287 or “hiking” they were categorised in the “physical activity” avoidance response if this
288 was not already marked in the affirmative. Due to the focus of the present study,
289 participants were classified as “avoiders” and “non-avoiders” based on whether they
290 had reported to have previously avoided physical activity due to the events of the
291 menstrual cycle. The impact of menstrual symptoms on physical activity avoidance was
292 based on similar single question components of absenteeism from work and school
293 (Fourquet et al., 2010; Houston et al., 2006).

294

295 Physical activity

296 Self-reported physical activity status was assessed based on the following criteria:
297 sedentary (walking less than 20 mins a day); slightly active (walk over 20 mins per
298 day); moderately active (undertake at least 20 mins of moderate physical activity per
299 day); very active (undertake 40 mins of moderate intensity physical activity per day);
300 athlete (high intensity exercise 5+ days a week). For the purpose of subsequent analysis,

301 as there were fewer than five participants within the sedentary and athlete categories,
302 the groups were condensed with their closest categories. The physical activity
303 classifications were therefore: sedentary-to-low activity, moderately active, high
304 activity-to-athlete. Despite retrospective recall having known limitations for accurately
305 quantifying daily physical activity (Lee et al., 2011), a single item physical activity
306 question is a valid approach for the purposes of participant classification as adopted in
307 the present study (Milton et al., 2013; Schechtman et al., 1991), with high test-retest
308 reliability ($r = 0.82$, Milton et al., 2011).

309

310 *Interviews*

311 Semi-structured interviews were conducted to (1) expand on the data obtained from
312 questionnaires (O’Cathain, 2010), (2) to facilitate the generation of new ideas that might
313 not have emerged from the sole use of quantitative methodology, and (3) to uncover the
314 subtleties underpinning participant perceptions ‘in diverse and enriched ways’ (Smith &
315 Sparkes, 2016, p. 3). They were useful to cover aspects important to the inquiry, while
316 rendering the flexibility to pose impromptu questions that encouraged participants to
317 express thoughts freely (Brinkmann & Kvale, 2018).

318 In this study, 21 interviews were conducted, of which seven took place face-to-
319 face and 14 via video call (FaceTime or WhatsApp). Prior to interview participation, the
320 women gave written consent to voluntary interview participation, to audio recording of
321 interviews, to transcription of these audio recordings, and to the use of anonymised,
322 direct quotes in published work (e.g., conference presentations, journal articles).
323 Interviews were informed by an interview guide, which outlined topics of interest and
324 example questions. Following a summary by the principal author of the purpose of

325 interviews, conversations then focused on understanding women’s physical activity
326 throughout the menstrual cycle (Warren, 2012). Interview questions explored how the
327 participants felt on days before, during, and after the period, what the participants’
328 physical activity looked like throughout the menstrual cycle, how participants felt about
329 themselves throughout the menstrual cycle, how menstrual symptoms, self-perceptions,
330 and social situations shaped physical activity on days of the period, and why the
331 participants thought, felt, and acted in certain ways. Participants were prompted to
332 expand on initial thoughts with questions, such as “How did this make you feel?”,
333 “Why do you think this way?” or “Can you give me an example?” Interviews were
334 audio-recorded and transcribed by the principal author for further interpretation
335 (Davidson, 2009).

336

337 ***Data analysis***

338 *Questionnaire*

339 All quantitative analyses were performed using IBM SPSS Statistics 24 software.
340 Where appropriate (i.e. ratio data), parametric assumptions of normal distribution were
341 confirmed using Shapiro-Wilk’s test ($p>0.05$) in all dependent variables, except for
342 height in both avoiders and non-avoiders ($p<0.05$). Group comparisons were made
343 using independent t-tests with equal variance (Levene’s, $p>0.05$) in all dependent
344 variables, other than pain (days/MC), fatigue (days/MC), and spotting (days/MC)
345 (Levene’s $p<0.05$). For comparison of group differences in height, the Mann-Whitney U
346 test was performed. All data are presented as mean (SD), with group differences
347 reported as: p , 95% confidence interval (CI) and effect size (d).

348 Nominal data was assessed using Chi-square associations for classifications of
349 pain, flow, contraception, and physical activity. Participants were grouped as avoiders
350 or non-avoiders, with subsequent post-hoc analysis performed if the Chi-square reached
351 significance ($p < 0.05$, for pain and flow). As only two classification were made for flow,
352 no post hoc was necessary. Whereas for pain, there were three classifications (no-mild,
353 moderate, and severe), in this instance cell-wise residual analysis was performed
354 (Garcia-Perez & Nunez-Anton, 2003), with the level of significance adjusted for the
355 three sub-classifications. For the nominal variables, a significant outcome of Chi square
356 is described as a significant association rather than a group difference based on previous
357 recommendations (Field, 2013; McHugh, 2013; Scott et al., 2013).

358

359 *Interviews*

360 Thematic analysis was utilised to identify patterns in the interview data and make sense
361 of their meaning (Braun et al., 2016). The principal author read anonymised interview
362 transcripts recurrently to define codes, which constituted of links between data and
363 ideas, and themes that helped identify commonalities and distinctions (Nowell et al.,
364 2017). She recognised this phase as an active process of meaning making and adopted
365 an iterative approach by working “back and forth” between interview data, preliminary
366 themes, and interpretations (Braun et al., 2016). Analytical questions included “What do
367 the participants’ physical activity routines look like?”, “How do menstrual events affect
368 the participants’ physical activity? Why is this so?”, “How do the participants think and
369 feel about factors affecting physical activity? Why do they think and feel in certain
370 ways?” To strengthen the credibility of interpretations, the principal author liaised with
371 members of the research team, who acted as critical friends and discussed

372 interpretations, prompted reflection, and explored interpretive avenues (Smith &
373 McGannon, 2018). In the latter stages of analysis and write-up, the dialogues also
374 explored opportunities to integrate the insights gained from questionnaires and
375 interviews to develop rich discussions of physical activity and the menstrual cycle.

376

377 **Results**

378 *Questionnaire results*

379 Of the 128 responders, 44 participants (34%) were classified as “avoider” and 84
380 participants (66%) were classified as “non-avoider” based on whether they had avoided
381 playing sport, going to the gym, or other physical activities due to their menstrual
382 events or discomfort.

383

384 *Participant demographics*

385 There was no significant difference in age, height or body mass between avoiders and
386 non-avoiders (Table 1).

387

388 *Menstrual characteristics*

389 Compared to non-avoiders, avoiders had periods that lasted 0.65 days longer ($t(126) = -$
390 $2.34, p < 0.05, CI [0.10, 1.20], d = 0.40$, Table 1). In terms of specific menstrual
391 symptoms, compared to non-avoiders over the course of a menstrual cycle, avoiders had
392 0.94 more days of bleeding ($t(126) = -2.464, p < 0.05, CI [0.18, 1.71], d = 0.46$), 0.98

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393 more days of fatigue ($t(126) = -4.769, p < 0.01, CI [1.30, 3.61], d = 0.33$) and 2.44 more
394 days of pain ($t(126) = -4.191, p < 0.01, CI [1.28, 3.61], d = 0.84$, Table 1). There was no
395 difference in days of spotting between avoiders and non-avoiders (Table 1).

396 Pain severity (numerical scale) was 62% higher in avoiders than non-avoiders
397 ($t(126) = -4.116, p < 0.01, CI [1.09, 2.96], d = 0.78$, Table 1). There was no significant
398 association between contraception use and physical activity avoidance ($X^2(2, N = 128)$
399 $= 2.06, p = 0.35$); with 61% and 57% using no form of hormonal contraceptive, 18.2%
400 and 11.9% using non-oral contraceptive, and 20.5% and 31% using some form of oral
401 contraceptive pill, in avoiders and non-avoiders, respectively.

402 There was no significant association between physical activity classification and
403 avoidance ($X^2(2, N = 128) = 2.73, p = 0.26$), with 20.5% avoiders and 11.9% non-
404 avoiders being sedentary or low physical activity, 54.5% avoiders and 51.2% non-
405 avoiders being active, and 25% avoiders and 36.9% non-avoiders being very active or
406 athlete.

407 There was a significant association between pain classification and avoidance
408 ($X^2(2, N = 128) = 14.5, p < 0.01$). Post hoc revealed that significantly less avoiders were
409 in the “no-to-mild” pain classification (20.5%) than non-avoiders (52.4%, $p < 0.01$).
410 Similar participant numbers were found for avoiders and non-avoiders in the moderate
411 pain classification (59.1% avoiders, and 41.7% of non-avoiders), and in the severe pain
412 classification (20.5% of avoiders and 6% of non-avoiders, $p < 0.04$, no significant
413 difference at the adjusted $\alpha = p < 0.017$).

414 There was a significant association between menstrual flow and avoidance
415 ($X^2(1, N = 128) = 22.3, p < 0.01$), 63.6% of avoiders were classified as heavy flow,
416 compared to 21.4% of non-avoiders. Similarly, 36.4% of avoiders were classified as
417 normal flow compared to 78.6% of non-avoiders.

418

419 Insert table 1 here.

420

421 *Interview results*

422 Following on from the questions posed throughout the data analysis, the results explore
423 women's experiences and management of physical activity as well as factors affecting
424 physical activity throughout the menstrual cycle, including menstrual symptoms,
425 personal perspectives, and social expectations. Throughout this section, pseudonyms
426 were used to protect the identity of participants.

427

428 *Periods and physical activity: Realities and experiences*

429 The women, who took part in interviews, spoke openly about the menstrual cycle and
430 shared personal experiences. Although participants referred to the period as the
431 menstrual cycle phase that had the greatest impact on physical activity, they equally
432 recognised the value of physical activity when coping with menstrual symptoms. It
433 became apparent that their perspectives were informed by an understanding of the
434 effects that physical activity had on physical and mental health. For instance, Val, Lisa,
435 and Elaine explained:

436 I think exercise has been a big help with my mental health. Even going for a walk.
437 I'll consciously do it because it makes me feel better. I feel lazy and more bloated
438 if I don't move much. (Val, Non-avoider)

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439 I think it's good for your longer term health. I know that people say exercise helps
440 with your periods. (Lisa, Avoider)

441 I think to begin with I was quite emotional because I wasn't active. With being
442 more consistently physically active, my mood swings are not bad at all. (Elaine,
443 Non-avoider)

444 Not only did the participants recognise the benefits of physical activity, but they also
445 sought to undertake it in everyday life. These women reported continuous physical
446 activity throughout the menstrual cycle and, in their recollections, demonstrated an
447 instilled sense of commitment. As an example, Olivia (Non-avoider) described why she
448 pushed herself to exercise:

449 I force myself to do things. I'm very active, so I tend to stay physically active. I
450 thank myself afterwards. It makes things better, especially the cramping and
451 sluggishness. All I want to do is tuck up in a ball on my bed. So forcing myself to
452 go to the gym is worth it because I do feel so much better after.

453 Sharing a perception of the period as something that should not limit activities of
454 everyday life, some of the participants felt as though they had no reason to skip the
455 gym. As a former professional dancer, Ava expected herself to commit to physical
456 activity even on days of the period. Throughout her career as a professional dancer, she
457 had developed a strong sense of commitment to routine training, which she had
458 transferred into her approaches to physical activity (Stephan, 2003). Holding high
459 expectations of herself, Ava (Non-avoider) differentiated the period from health
460 problems or injuries and explained:

461 There's no injury or pain that's preventing me from going. I just feel unwell. I'd
462 rather not go when I'm too tired or something is wrong with me. I think, "Okay
463 well at least you went and maybe don't go another time." There's no actual
464 physical reason for me not to go. It's a subjective feeling.

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465 Likewise, Nina (Non-avoider) described that she sought continuity in her routines:

466 I usually have a day at the start of my period, when I'm a bit off. If I planned a
467 session, I would do it and leave it behind me. I'm keen to follow my routines
468 because I don't think that my periods are strong enough. There is no need for me to
469 change things. I'm always challenging my brain whether I need to change
470 something or whether I can try it.

471 It is noteworthy that the above-presented data extracts stem from interviews with
472 women, who described their menstrual symptoms as manageable and therefore did not
473 feel the need to avoid physical activity. Many participants, however, did describe
474 avoidance of behaviours; either of physical activity environments (e.g., the gym) or of
475 exercises (e.g., abdominal work) and types of exercise (e.g., cardiovascular training).
476 The majority of conversations in this context therefore focused on the adaptations made
477 to maintain some level of physical activity. None of the participants scheduled
478 avoidance of physical activity due to menstrual events. Rather, symptoms had to be
479 managed *in situ* and often left the participants feel unable to follow their "normal"
480 physical activity routines. As an example, Willow (Non-avoider) changed her workouts
481 to avoid the frustration she associated with not being able to perform the way she would
482 on days when she did not have the period. She explained:

483 On my period, I don't feel like my workouts are as productive. I will swap what I
484 do. I tend to focus more on upper body to avoid the annoyance I have if I have a
485 bad session and I'd probably stay away from cardio.

486 For Hannah (Avoider), the first day of the period usually meant avoiding physical
487 activity completely:

488 Sometimes I get home from work on the first day and think, "Forget it, not this
489 week", and just stay at home. Then on later days, when I do decide to go for a run

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490 or do exercise, I wouldn't put as much effort in. I'd choose an easier class rather
491 than a more intense one.

492 For Scarlett and Harper, the discomfort of using sanitary products led them to alter
493 routines:

494 I do a lot of running and I don't really do that when I'm on my period. The
495 sensation feels weird, so I stick to weight bearing exercises. The feeling's not there
496 as much when I do that. I don't wear tampons because I find them uncomfortable,
497 so I wear sanitary towels and I always wonder, "Oh have they moved?" ... it's
498 about where the pad is and it can get sore. It doesn't stop me but instead of doing
499 half an hour, I might only do ten minutes of cardio. Or I'd sit on a bike instead of
500 running because it's not moving as much. (Scarlett, Non-avoider)

501 I'd go to the gym, but perhaps not do cardio. Because of my injured knee, I can't
502 run and sitting on a bike with a pad or tampon is really uncomfortable. That would
503 ruin my gym session. So, sessions don't last as long. I probably do more upper
504 body than lower body. I don't think I do abs when I'm on my period. Especially
505 crunches or sit-ups when you've got a pad on. It's not nice at all. (Harper, Avoider)

506

507 *Symptoms, self, and social – Factors shaping physical activity*

508 Interview participants recalled a variety of factors affecting the ways in which they
509 managed physical activity throughout the menstrual cycle. Their suggestions broadly
510 related to the symptoms associated with the period, to perceptions of self, and to social
511 expectations.

512 The most prominent influence on women's physical activity routines was the
513 perceived severity of menstrual symptoms. Although the types of symptoms, their
514 duration, and occurrence varied, they commonly included abdominal cramps, headaches

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515 and backaches, leg pains, lethargy and fatigue. The following data extracts are examples
516 of the symptoms described by interview participants:

517 I suffer most with sciatica-type leg pain. I'm extremely lethargic to the point where
518 it's almost debilitating. Migraines as well, feeling dizzy and muggy. (Piper,
519 Avider)

520 Normally I'm an energetic person, but when it's that time I'm tired. I can be
521 moody, but it's mainly tiredness. I don't feel I have my normal amount of energy.
522 (Hannah, Avider)

523 My body changes completely. When I put on a pair of trousers that are normally
524 loose, they're tighter. My stomach feels heavy. And the fatigue! (Mary, Avider)

525 There were a couple of times, where I woke up in the morning and planned to go
526 for a run, but then the cramps were so bad that I couldn't get out of bed. (Olivia,
527 Non-avoider)

528 In addition to feeling physically unwell, many participants also spoke of a heightened
529 sense of self-consciousness. The period affected how women thought about themselves
530 and how they felt in their own skin. Interestingly, these perceptions were not only
531 limited to those who avoided (certain aspects of) physical activity, but were also shared
532 by those who made efforts to maintain activity levels throughout the menstrual cycle.
533 As an example, Harper (Avider), described:

534 You're not your usual self. You just feel you're on the period. For me it's at the
535 start, but at that point, it's always there that thought. Just like hyper aware of it.

536 For Val and Caroline, feelings of consciousness led them to carefully select clothes
537 worn in physical activity environments. The participants recalled, respectively:

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538 I'm really conscious if I wear shorts or if my leggings are see through or thinking
539 whether I've leaked. I'm more aware of what I do and how that might look. (Val,
540 Non-avoider)
541 I suppose with netball, I am conscious of what to wear because of the small shorts
542 and dresses that we have to wear. I always wear a tampon over a towel and
543 underwear that keeps everything in check. I actually saw a girl at netball a couple
544 of years ago. You could see her pad through the shorts and I felt bad for her but
545 nobody said anything. (Caroline, Non-avoider)

546 Beyond the sense of self-awareness, the perceived expectations others might have about
547 menstrual events, shaped women's physical activity routines. Interview participants
548 commonly referred to worries of being "found out" by others, recalled an awkwardness
549 surrounding periods, and described subsequent discomfort in certain physical activity
550 environments. For example, Lisa and Scarlett preferred to avoid the gym on days of
551 heavier flow due to concerns over how others might react if they discovered the reasons
552 for which they did not adhere to usual routines:

553 The gym is a social place for me. I know a lot of people. They would know I
554 wasn't on top form. My PT would say, "Why are you lifting this today?" I
555 wouldn't wanna turn around, "I feel shit because of my period." I don't know how
556 he would handle that, what his feelings would be. That's where I suppose that
557 taboo comes in because I wouldn't go, "I'm taking it easy today because I'm on
558 my period." Even though I say I talk about periods, I guess I don't because I'd
559 rather avoid telling them that I was going easy because of my period. (Lisa,
560 Avoider)

561 In the first days when I'm heaviest, I feel embarrassed. I don't want other people to
562 know. I'm scared that if I get out of the pool, blood is gonna run down my leg. I'm
563 worried what other people would say. Especially with men in the gym. Someone
564 might put me down and I wouldn't wanna go to the gym anymore. (Scarlett, Non-
565 avoider)

566 Other participants perceived pressure to maintain their attendance at training sessions

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567 and believed there were expectations for women to carry on “as normal” regardless of
568 discomfort due to menstrual events. For Hannah and Harper, playing netball was not
569 only important at a personal level, but also in a social context (Weiss, 2015). It was
570 therefore to be continued throughout the menstrual cycle. The participants’ perceptions
571 of expectations and understandings that teammates and coaches might hold shaped their
572 dedication to the sport (Weiss et al., 2010). They explained:

573 With netball, you’ve got to go. There’s no choice. In my netball team, if you don’t
574 train, you don’t get played at the match. You’ve got that pressure. Also we pay for
575 training and matches, so you don’t want to waste money by not going. (Hannah,
576 Avoider)

577 When I played netball, I couldn’t turn around to the team and say, “I can’t play.
578 I’m on my period.” Someone might say, “I’m on my period too and I’m playing.”
579 Especially in a team of girls. You can’t let them down when they all know how it
580 feels. (Harper, Avoider)

581 Similarly, Mila and Nina believed that it was expected of women to disguise any signs
582 of menstrual events. In Mila’s (Non-avoider) words:

583 When I’m on the period I don’t want anyone to find out I’m not feeling hundred
584 percent. Maybe I complain to a female co-worker or friend but I would never,
585 even, if I called in sick, I wouldn’t admit it’s period-related. I would say I am not
586 well. I think the expectation to carry on as usual is always there.

587 Nina (Non-avoider) explained:

588 Nobody ever told me that I need to hide my tampon when I go to the loo at the
589 gym, but I do it. Because I think, other people aren’t as relaxed as me about
590 periods. We don’t talk about them. If we do, it’s awkward.

591

592 **Discussion**

593 This mixed-methods study utilised an online questionnaire to quantify events relating to
594 the menstrual cycle and physical activity as well as semi-structured interviews to
595 explore women's lived experiences of physical activity throughout the menstrual cycle.
596 The discussion draws together quantitative and qualitative results to provide rich
597 interpretations of the questionnaire and interview data (O'Cathain, 2010).

598 In the present study, the majority of women who completed the questionnaire
599 (84 of 128 women – Table 1) were categorised as non-avoiders of physical activity due
600 to events of the menstrual cycle. Interview data revealed that the participants recognised
601 the importance of physical activity and the benefits it brought to their lives. Through
602 experiences in their upbringing, education, and employment, they had learned about the
603 advantages of physical activity, which in turn affected their experiences of and
604 commitment to physical activity throughout the menstrual cycle. Consistent with the
605 knowledge that the present participants possessed, previous research has shown that
606 connections existed between people's awareness of physical activity recommendations
607 and their actual levels of physical activity (Plotnikoff et al., 2011). Those who knew
608 about health recommendations tended to be more physically active in everyday life
609 compared to those, who did not possess this level of understanding (Fredriksson et al.,
610 2018). This was so especially when individuals knew not only about guidelines, but also
611 about the health benefits associated with moderate physical activity (Heinrich et al.,
612 2011). Interview data in the present study revealed that the participants had actually
613 experienced positive post-workout effects on days of the period, for instance, uplifted
614 emotional state, reduced pain, and increased feelings of accomplishment. This finding is
615 in line with studies illustrating that exercise could alleviate menstrual symptoms (e.g.,
616 backaches – Chen & Hu, 2019) and enhance mental wellbeing throughout the menstrual

617 cycle (Kanojia et al., 2013). Physical activity has also been considered as a
618 complementary treatment for dysmenorrhea (Samy et al., 2019) as it reduced the
619 duration and severity of menstrual cramps (Dehnavi et al., 2018; Kannan et al., 2015).

620 In partial agreement with our hypothesis, one third of questionnaire respondents
621 (44 of 128 participants) were categorised as avoiders of physical activity due to
622 menstrual events (Table 1). This could be attributed to these avoiders having more
623 severe menstrual symptoms, including longer periods, higher levels of pain and fatigue,
624 and heavier flow as reflected in the questionnaire data. Despite the potential bias of
625 menstrual recall (as discussed in detail in the methods) the qualitative data confirmed
626 that women could not overlook menstrual events (e.g., bleeding and pain) and when
627 considering whether to avoid physical activity, interviews revealed that the participants
628 evaluated the severity of menstrual symptoms. For instance, symptoms that the women
629 perceived as severe (e.g., migraines and abdominal pain) led the participants to avoid
630 physical activity completely. This complete avoidance is comparable to recurrent school
631 absence in adolescent women who suffered from dysmenorrhea (Houston et al., 2006).
632 In adult women, missing university or workdays represented a common self-
633 management strategy for painful periods (Chen et al., 2016). The present study
634 participants confirmed that the period had to be managed (e.g., sanitary products) and
635 taken into account in physical activity routines (e.g., types of exercises). The women in
636 this research described the days of the period as limiting their ability to function as what
637 they perceived “normal” for themselves. In particular, a combination of physical
638 symptoms, lacking “energy” and motivation made it more challenging for the
639 participants to perform physical activity as normal. These findings resonate with studies
640 on the impact of the menstrual cycle on physical performance, such as through anaemia
641 from heavy menstrual bleeding (Bruinvels et al., 2016), higher body temperature during

642 exercise in the luteal phase (De Jonge & Janse, 2003), and lower fatigue resistance in
643 the pre-menstrual phase (Ansdell et al., 2019).

644 The present study participants, however, did not necessarily avoid all forms of
645 physical activity on days of the period (a nuance not captured within the questionnaire).
646 Although the questionnaire data showed no significant relationship between physical
647 activity classification and avoidance, interviews were particularly useful to make sense
648 of this observation and to unpack the subtleties underpinning women's reports of
649 physical activity avoidance due to menstrual events without necessarily being less
650 physically active overall. Indeed, interviews uncovered aspects of physical activity
651 adaptation that have been previously unreported. Some of the participants, who reported
652 to avoid physical activity, did not avoid all forms of activity and instead, changed
653 exercise routines, used alternative physical activity or made up for missed physical
654 activity on days when they felt less affected by menstrual symptoms. Often, it was
655 about adapting routines depending on the perceived severity of menstrual symptoms and
656 levels of discomfort, consistent with previous work showing adaptations to activities of
657 daily life due to menstrual symptoms (Kennett et al., 2016). The selective avoidance
658 and modification of physical activity was routine to some participants and could reflect
659 women's knowledge about the benefits of physical activity to their health, physical
660 wellbeing, and mood (Fredriksson et al., 2018). Similar to women who selectively
661 avoided tasks in the workplace (e.g., meetings) due to reduced concentration, patience,
662 and efficiency (Brantelid et al., 2014), some of the present interview participants only
663 avoided physical activity that caused discomfort (e.g., lower body workouts), while
664 continuing more manageable activities (e.g., walking and upper body workouts), when
665 they believed that they could maintain some level of activity. This selective avoidance
666 of physical activity is comparable to reports of adaptation as a way to maintain physical

667 activity levels in other populations, such as pregnant women suffering from backaches
668 (Cioffi et al., 2010) as well as individuals suffering from chronic fatigue syndrome
669 (Larun & Malterud, 2011) and migraines (Buse et al., 2012).

670 Aside from the menstrual symptoms, our qualitative findings demonstrated how
671 self-perceptions and perceptions of social expectations influenced physical activity.
672 Interviews revealed that the participants had concerns about leakage of blood, product
673 use, and pain management in the presence of other people in physical activity
674 environments. Similar to women, whose commitment to exercise suffered from
675 heightened body consciousness in physical activity environments (Pridgeon & Grogan,
676 2012), several women in the present study described a heightened sense of self-
677 awareness on days of the period that led to careful selection of clothes and exercises.
678 Comparably, heightened consciousness in public spaces was previously described in
679 women, who felt their bodies did not conform to predefined norms of femininity, such
680 as female bodybuilders in the presence of casual gym visitors, in public (Shilling &
681 Bunsell, 2009), and when sharing photos of their physique on social media (Marshall et
682 al., 2019). In the present study, the perceptions of self in physical activity environments
683 were closely connected to concerns over what others might say if they found out about
684 women's menstrual events. Sensations, such as bleeding, pain, and fatigue, associated
685 with the period in particular, were to be "dealt with" in private. This persisted even
686 though the interview participants had reframed their own views of menstrual events and
687 felt comfortable to talk about them (Lee, 2002). The participants believed, however, that
688 upbringing and societal norms of the period in particular as something shameful and
689 embarrassing led women to silence and conceal (signs of) the period (e.g., blood and
690 sanitary product) (Chrisler et al., 2015; Spadaro et al., 2018). The concerns of women in
691 the present study about how others might react to signs of the period point towards

692 social stigma surrounding menstrual events that led women to avoid and adapt physical
693 activity (Johnston-Robledo & Chrisler, 2013; Kowalski & Chapple, 2000). Such stigma
694 surrounding exercise during the period has been similarly reported in overweight
695 individuals (Vartanian & Novak, 2011), people with mobility impairments (Mulligan et
696 al., 2017), and the LGBTQ+ community (Herrick & Duncan, 2018) undertaking
697 physical activity.

698 Due to the paucity of data on the impact of the menstrual cycle on physical
699 activity, in order to test our proposed hypothesis, it was necessary to construct the
700 components of the questionnaire from a number of different sources. These sources
701 have been acknowledged throughout the methods section including recall of menstrual
702 symptoms (Matteson et al., 2015), menstrual pain (Larroy, 2002), menstrual flow
703 heaviness (Fraser et al., 2015), avoidance (Fourquet et al., 2010), and physical activity
704 (Milton et al., 2011). Through adopting these previously validated components of the
705 questionnaire, we can state our main finding that physical activity avoiders have
706 heavier, longer, and more painful periods, despite the limitation that no assessment of
707 reliability or validity has been performed on the entirety of the questionnaire. It is
708 important to note however, that based on the nuanced responses from the interviews,
709 emphasising adaptation, over avoidance, future questionnaires on physical activity
710 within the menstrual cycle should be validated for both avoidance and adaptation.

711 In developing our questionnaire, our aim was to identify whether physical
712 activity avoidance could be attributed to menstrual symptoms. There are a wide range of
713 demographic co-variables that are unreported in the present study including education,
714 employment status, religious background, socio-economic level and ethnicity (e.g.,
715 Mondragon & Txertudi, 2019). As the area of physical activity avoidance due to
716 menstrual symptoms is underreported in general, our aim was to provide the first

717 overview of the impact of the menstrual cycle on physical activity. In future studies, the
718 prevalence of physical activity avoidance may therefore be different to the present
719 study, if presented based on some of these demographic groupings.

720 Our study demonstrated that binary measures of physical activity, such as those
721 utilised in the present questionnaire, miss the nuances that underpin avoidance
722 behaviours. The use of quantitative and qualitative methodology was therefore
723 particularly useful to developing nuanced views of factors affecting physical activity,
724 which included, but were not exclusive to, menstrual symptoms. Other important
725 considerations that shaped women's physical activity related to perceptions of "self"
726 and social expectations about menstrual events; two areas that need to be confronted in
727 greater depth. Future research might therefore seek to employ qualitative methodology
728 to understand women's self-presentations (e.g., Goffman, 1956) and the role of social
729 stigma (e.g., Goffman, 1963) in physical activity environments. The participants in the
730 present study understood the importance of physical activity to maintain a healthy
731 lifestyle and they enjoyed being physically active. We acknowledge, however, that the
732 limited sample size and volunteer nature of interview participation could be considered
733 limitations of this study. Although comparable sample sizes were suggested in
734 methodological texts (Onwuegbuzie & Collins, 2007) and mixed-methods research
735 investigating the menstrual cycle (Moreno-Black & Vallianatos, 2005) and voluntary
736 interviews were conducted to ensure ethical research practice (e.g., Hammersley &
737 Traianou, 2012), we recognise that our decisions might have resulted in unreported
738 differences between the present participants and those, who did not volunteer for
739 interview participation. As with the limitations of the questionnaire outlined above, a
740 worthwhile line of inquiry would therefore be to investigate how other demographic
741 groups approach physical activity throughout the menstrual cycle. In particular, the

742 impact that the combination of menstrual symptoms, self-perceptions, and social norms
743 might have on physical activity warrants further research attention. In this context, it
744 would be of interest to explore women's familiarity with their own menstrual cycle and
745 to unpack their typical involvement in physical activity in order to understand how
746 differences among women in these areas might affect their management of physical
747 activity throughout the menstrual cycle.

748 In conclusion, the present study suggests that menstrual events are complex,
749 individual, and personal to the women experiencing them (e.g., Brantelid et al., 2014).
750 The results demonstrated that women did not simply avoid all physical activity. Rather,
751 they adapted physical activity depending on their distinct experiences of the menstrual
752 cycle. This insight into the multi-faceted effects that the menstrual cycle could have on
753 women's physical activity is pertinent to practitioners in the field. Creating safe spaces
754 for women who wish to speak about how their physical comfort, personal thoughts, and
755 perceptions of social norms might affect physical activity is important. Efforts in
756 academic and practitioner fields could contribute to normalising conversations about the
757 menstrual cycle (Johnston-Robledo & Chrisler, 2013; Kowalski & Chapple, 2000) and
758 support physical activity throughout the menstrual cycle in women of all ages and
759 abilities.

760

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1050 **Tables**

1051 Table 1. Mean (SD) participant characteristics and menstrual cycle symptoms taken
 1052 from the questionnaire.

	All	Avoider	Non-avoider
N	128	44	84
Age (yrs)	27.9 (7.5)	28.2 (8.0)	27.2 (7.3)
Height (m)	1.65 (0.06)	1.65 (0.06)	1.65 (0.06)
Body mass (kg)	63.2 (12.2)	61.9 (12.8)	63.8 (11.8)
Length of period (days)	4.64 (1.80)	5.07 (1.11)*	4.42 (2.04)
Bleeding (days/MC)	3.81 (2.10)	4.43 (2.07)*	3.49 (2.05)
Spotting (days/MC)	1.51 (1.80)	2.02 (2.37)	1.24 (1.35)
Fatigue (days/MC)	2.82 (2.99)	4.43 (3.45)†	3.45 (2.34)
Pain (days/MC)	2.60 (2.87)	4.20 (3.60)†	1.76 (1.95)
Pain severity (numerical scale)	3.95 (2.80)	5.27 (2.41)†	3.25 (2.75)

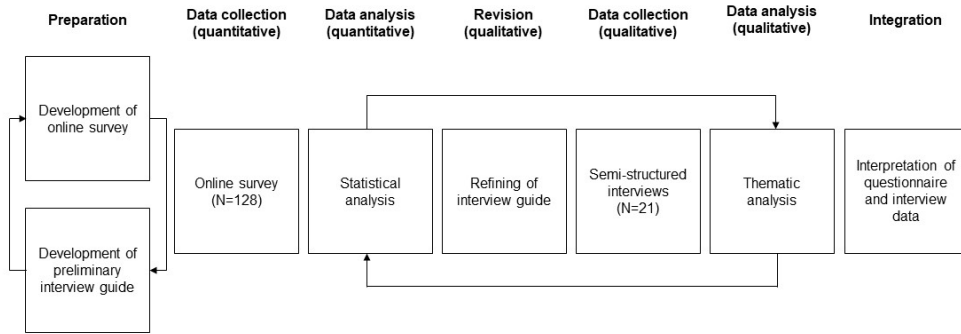
1053 MC, menstrual cycle. *denotes significant difference from non-avoider ($p<0.05$),

1054 †denotes significant difference from non-avoider ($p<0.01$).

1055

1056 **Figures**

1057 Figure 1. Overview of study design (adapted from Ivankova, 2014)



1058