## CLINICAL PAPER

# Prevalence of pelvic floor dysfunction in recreational athletes: a cross-sectional survey

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**Abstract**

*Introduction and hypothesis.* Pelvic floor dysfunction (PFD) affects many women, and participation in elite sport and high-impact exercise has been reported as a potential risk. However, few studies have investigated the effects of exercising at recreational levels on PFD. The authors' aim was to investigate levels of PFD in women exercising at, or above, UK guidelines for health, and compare these with levels in non-exercisers.

*Method.* Data on levels of PFD and potential risk factors (i.e. age, hormonal status, body mass index, constipation, parity, forceps delivery and recreational exercise) were collected using a cross-sectional survey distributed via social media. The International Consultation Incontinence Questionnaire (ICIQ) – Urinary Incontinence Short Form was used to estimate the prevalence of urinary incontinence. Selected questions from the ICIQ – Vaginal Symptoms and Bowel Symptoms questionnaires were used to estimate the prevalence of anal incontinence (AI) and pelvic organ prolapse. Logistic regression analysis was used to compare exercisers and non-exercisers after adjusting for potential confounders.

*Results.* The authors recruited 1598 adult women (1141 exercisers and 457 non-exercisers). The majority were parous. A high prevalence of urinary incontinence (70%), AI (48%) and pelvic organ prolapse (18%) was reported. No significant association was found between recreational exercise and PFD despite adjustment for confounders, or further investigation regarding exercise involving impact, although some increased reporting of AI was seen in those exercising for over 10 h per week.

*Conclusion.* High levels of PFD were reported, but no significant association was found between recreational exercise and symptoms. However, data suggest that women modify their exercise regimes as required. Few symptomatic women sought professional help.

*Keywords:* female athlete, incontinence, pelvic floor, pelvic organ prolapse, prevalence.

## Introduction

Pelvic floor dysfunction (PFD), which includes urinary incontinence (UI), anal incontinence (AI) and pelvic organ prolapse (POP) (Haylen *et al.* 2010), causes embarrassment and distress, limits many aspects of life (Nilsson *et al.* 2009) and affects many women (Nygaard *et al.* 2008). It is accepted that childbirth, obesity and ageing are risk factors for PFD (Danforth *et al.* 2006), but recent evidence suggests that the prevalence of UI in young, nulliparous athletic women is 2.77 times higher than in their sedentary counterparts (Teixeira *et al.* 2018). Other reports suggest that high-impact activities (e.g. cheer leading) may be linked with increased levels of AI (Vitton *et al.* 2011). However, regular participation in sport and exercise confers multiple health benefits (Warburton *et al.* 2006; Lewis & Hennekens 2016). Current UK recommendations are that adults should exercise at moderate levels or above for a minimum of 150 min each week over three sessions (DHSC 2019). Urinary incontinence can be a barrier to exercise (Nygaard *et al.* 2005), and concern regarding potential risks to the pelvic floor, as reported

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in elite athletes, may cause health professionals and women to question the safety of engaging in sport and exercise, for fear of aggravating symptoms or increasing the risk of developing PFD. Although studies have investigated whether the risk of PFD is higher in elite athletes than in sedentary individuals (Carvalhais *et al.* 2018) and in younger women (Vitton *et al.* 2011; Almeida *et al.* 2016), only a few have reported levels within a broad range of recreational athletes (McKenzie *et al.* 2016; Forner *et al.* 2020). Therefore, the objectives of the present study were:

(1) to investigate the levels of PFD reported by women who exercise at or above UK guidelines for healthy living, and in those who are more sedentary; and
(2) to investigate any association between PFD and taking part in sport at a recreational level

## Materials and methods

### *Study design*

The present study was a cross-sectional survey specifically designed to investigate levels of UI, AI and POP in a convenience sample of adult women, and the results were reported using the Strengthening the Reporting of Observational Studies in Epidemiology guidelines (Von Elm *et al.* 2007). The study steering group, comprising the authors, and a patient and public involvement member, designed the survey and developed it on Jisc online surveys (Jisc, Bristol, UK). The survey contained 37 questions that were divided into sections so that participants could bypass those that did not apply to them. It was initially piloted with 31 participants recruited from administrative and academic staff from the School of Health Sciences, University of Nottingham, and a local physiotherapy clinic, to identify any issues with the language or question format. Minor signposting problems and issues with terminology identified were resolved.

### *Sample size*

In order to investigate a predicted potential significant difference of 10% in the prevalence of PFD between recreational exercisers (McKenzie *et al.* 2016) and the general female population (Cooper *et al.* 2015), with the significance level set to 0.05 and 80% power, the present authors aimed to recruit a minimum of 800 participants: 500 exercisers and 300 non-exercisers.

### *Participants and recruitment*

Adult women were invited to take part via advertisements, which were widely distributed on social media networks (i.e. Facebook, Twitter, Instagram and LinkedIn), and using snowball methodology (i.e. asking people to share the information with others). Posters were also distributed to sports clubs, workplaces and physiotherapy clinics for display on websites and noticeboards. Quick response codes linked directly to the survey. Advertisements highlighted that *all* women were invited to take part: both those who did and those who did not exercise, and both those with and those without any pelvic floor symptoms. Data collection took place between 6 May and 31 July 2022.

### *Outcome measures*

To determine the prevalence of UI, AI and POP [as defined by the International Urogynaecological Association (IUGA)/International Continence Society (ICS) joint report; Haylen *et al.* 2010], the present authors collected data using patient-reported outcome measures. They used the International Consultation on Incontinence Questionnaire (ICIQ) – Urinary Incontinence Short Form (ICIQ-UI SF) (Avery *et al.* 2004) in its entirety, and specific questions of interest from ICIQ – Bowel Symptoms (Cotterill *et al.* 2011) and Vaginal Symptoms questionnaires (Price *et al.* 2006). Inclusion of all three questionnaires in full would have resulted in a prohibitively time-consuming survey, one likely to deter participation.

Those who reported "never" in response to the question "How often do you leak urine?" were classified as continent of urine, and severity was defined by the ICIQ-UI SF severity score (Klovning *et al.* 2009). Urinary incontinence was further subdivided into stress UI (SUI), urgency UI (UUI) and mixed UI (MUI) based on the answers to "When does urine leak?" Anal continence was identified in those who answered "always" to the question "Are you able to control leakage of stool or flatus (wind) from your back passage?" Responding "never" to the question "Are you aware of a lump or bulge coming down in your vagina?" was taken to indicate the absence of POP. Awareness of a lump or bulge in the vagina has been associated with the presence of a grade 2 POP, although this may underestimate the true prevalence of this dysfunction (Barber *et al.* 2006). Age, menopausal status, body mass index (BMI), constipation (defined as regularly having to strain to open bowels), parity

and type of delivery were considered potential risk factors for PFD and possible confounders.

Recreational athletes were defined to be those who met and exceeded the UK Chief Medical Officers' guidelines for healthy living of 150 min a week (DHSC 2019). This was further subdivided into high-impact (sports involving both feet leaving the ground at the same time, e.g. running, high-impact gym or trampolining) and low-impact (one foot always in contact with the ground or body weight supported, e.g. walking, cycling or kayaking) exercise, or both.

Additionally, participants were asked if they had sought professional help for PFD, and if they regularly performed pelvic floor muscle exercises (PFMEs). The final open question gave participants an opportunity to record comments or additional information regarding previous answers.

### *Statistical analysis*

Statistical analysis was performed in SPSS Statistics, Version 28 (IBM, Chicago, IL, USA). Demographic data were reported using frequencies with percentages or means with standard deviations (SDs). Prevalence was reported as frequency and percentage, and Pearson's $\chi^2$ test was used to investigate any differences in the prevalence of PFD between non-exercisers and exercisers. Missing data were reported. Risk factors for PFD were estimated by logistic binomial regression analysis, and reported as adjusted odds ratios (ORs) with 95% confidence intervals (CIs), with the significance level set to 0.05.

## Results

Visits to the survey site were recorded to be 4985: 3185 exiting after the first page (survey information). A few individuals then exited from subsequent pages, but most who progressed to consent then completed the survey (Fig. 1). Individual Internet Protocol addresses were not collected as a result of the anonymizing process, so it is not possible to calculate participation rate; each visit recorded could represent duplicate visits by the same participant or unique visits.

In total, 1600 participants consented to take part and submitted data. Two were excluded: one self-identified as a man, noting that they were male at birth, but wished to underline the need for a similar survey for men; and one did not provide key data regarding birth history, menopausal status and exercise history. Data submitted by the remaining 1598 participants were analysed: of these, 1141 (71%) reported exercise levels above UK guidelines of more than 150 min per week, and 457 (29%) did not exercise or were below this level. Most exercisers (921, 81%) reported doing so for over 5 years, and 1041 (91%) exercised more than three times per week, in line with guidelines. Owing to an initial system issue, eight participants were able to bypass some questions regarding bowel and vaginal symptoms, which is noted within the results tables.

### *Demographics*

A majority, 1359 (85%), of participants were UK-based, and 144 (9%) were based in the USA, Canada and Australia. All age groups were represented, but most, i.e. 1064 (67%), were under 50 years of age, and 954 (60%) self-identified as being pre-menopausal. The majority, 1347 (84%), were educated to degree level or above (used to estimate health literacy levels). The average BMI of the participants was 25.4 kg/m$^2$ (SD = 5.02, range = 15.0–51.6), i.e. slightly above normal (18.5–24.9 kg/m$^2$). Most, i.e. 1105 (69%), were parous, over half of these reporting two births and 13% had experienced a forceps delivery (Table 1).

### *Main outcomes*

*Prevalence.* Bladder: 1120 participants (70%, 95% CI = 68–72%) reported UI, 592 (37%) SUI, 180 (11%) UUI and 294 (18%) MUI. Bowel: faecal urgency was reported by 450 participants (28%, 95% CI = 26–30%), 769 (48%, 95% CI = 46–51%) reported difficulty controlling flatus and/or stool (AI), and 276 (17%, 95% CI = 16–19%) noted marking of underwear by stool. Prolapse: 293 women (18%, 95% CI = 17–20%) noted the sensation of bulging in the vagina.

*Associations.* There were no significant between-group differences regarding exercisers and non-exercisers in levels of UI ($P = 0.352$), AI ($P = 0.182$) or POP ($P = 0.152$). Exercisers were less likely to report constipation: 17% compared with 22% of non-exercisers ($P = 0.019$; Table 2).

After regression analysis using logistic binomial regression to account for other risk factors (i.e. age, reduced oestrogen, BMI, constipation, parity and forceps delivery) with non-exercisers (< 2.5 h per week) as the reference group, no significant association was found between recreational exercise and PFD.

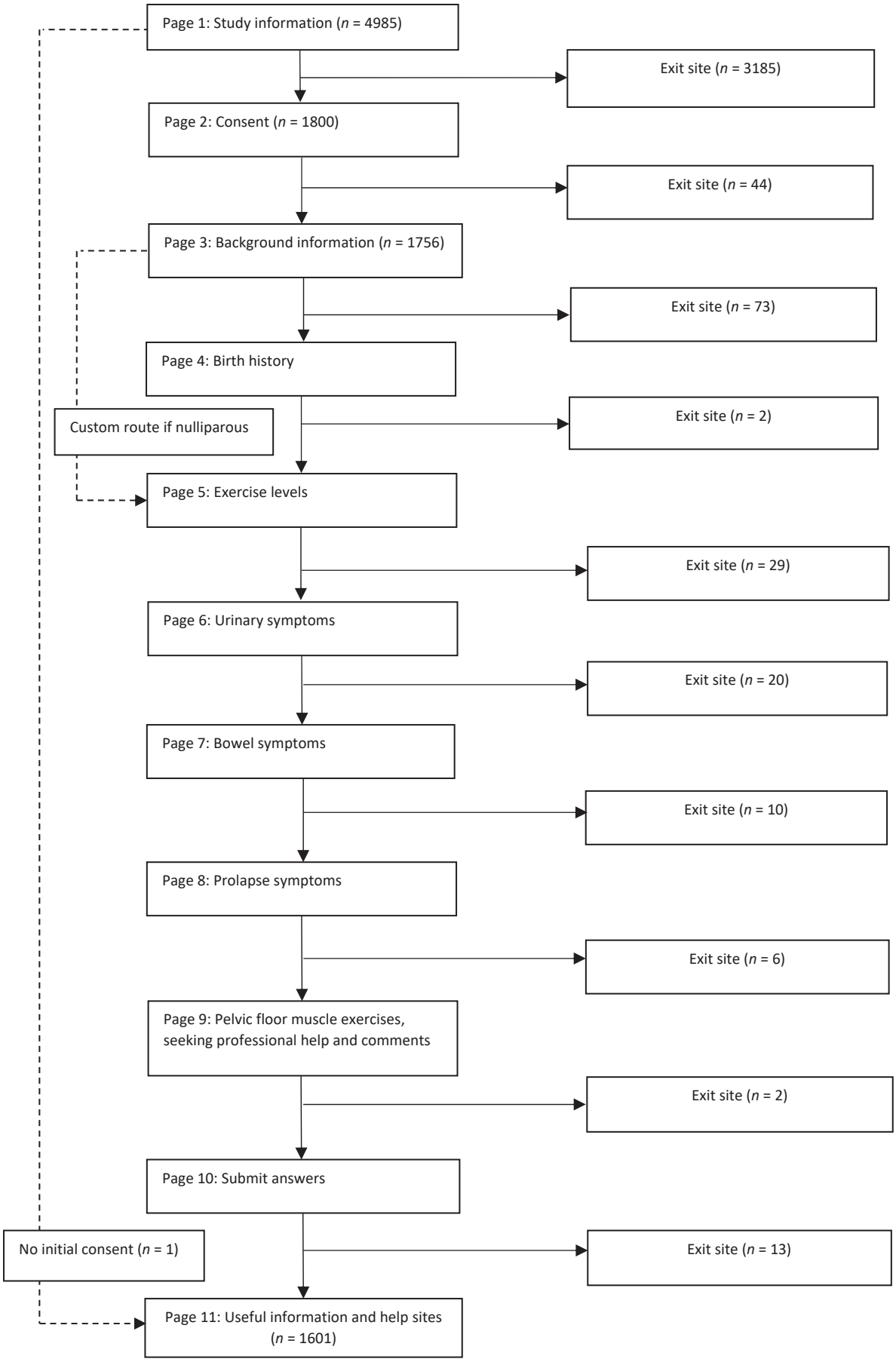


**Figure 1.** Flow chart to illustrate site visits and points of exit. N.B. As the process was anonymous, no unique Internet Protocol addresses were saved, so it was not possible to differentiate exits by unique visitors and repeat visits.

**Table 1.** Characteristics of participants: (HRT) hormone replacement therapy

| Characteristic | Participants [*n* (%)] | | |
|---|---|---|---|
| | Total (*n* = 1598) | Non-exercisers [*n* = 457 (< 2.5 h/week)] | Exercisers [*n* = 1141 (> 2.5 h/week)] |
| Age (years): | | | |
| 18–36 | 382 (23.9) | 112 (24.5) | 270 (23.6) |
| 37–50 | 682 (42.7) | 205 (44.9) | 477 (41.8) |
| 51–65 | 463 (29.0) | 112 (24.5) | 351 (30.8) |
| > 65 | 71 (4.4) | 28 (6.1) | 43 (3.8) |
| Premenopausal | 954 (59.7) | 276 (60.4) | 678 (59.4) |
| Menopausal/postmenopausal (on HRT) | 147 (9.2) | 40 (8.8) | 107 (9.4) |
| Menopausal/postmenopausal (not on HRT) | 497 (31.1) | 141 (30.9) | 356 (31.2) |
| Education level: | | | |
| high school | 251 (15.7) | 74 (16.2) | 177 (15.5) |
| graduate | 584 (36.5) | 165 (36.1) | 419 (36.7) |
| postgraduate | 763 (47.8) | 218 (47.7) | 545 (47.8) |
| Body mass index:* | | | |
| underweight/normal (< 24.9 kg/m$^2$) | 925 (57.9) | 218 (47.7) | 707 (62.0) |
| overweight (25–29.9 kg/m$^2$) | 397 (24.8) | 120 (26.3) | 277 (24.3) |
| obese (> 30 kg/m$^2$) | 276 (17.3) | 119 (26.0) | 157 (13.7) |
| Straining to defecate | 289 (18.1) | 99 (21.7) | 190 (16.7) |
| Parity: | | | |
| 0 | 493 (30.9) | 100 (21.9) | 393 (34.4) |
| 1 | 256 (16.0) | 86 (18.8) | 170 (14.9) |
| 2 | 616 (38.5) | 194 (42.5) | 422 (37.0) |
| 3 | 189 (11.8) | 65 (14.2) | 124 (10.9) |
| 4+ | 44 (2.8) | 12 (2.6) | 32 (2.8) |
| forceps | 208 (13.0) | 68 (14.9) | 140 (12.3) |

*Body mass index [mean (standard deviation, minimum to maximum)]: 25.4 (5.02, 15.0–51.6), 26.7 (5.5, 16.4–33.8) and 24.9 (4.75, 15.0–51.6) kg/m$^2$ for the total number of participants, and non-exercisers and exercisers, respectively.

**Table 2.** Reported symptoms of pelvic floor dysfunction (all presented as frequency and within-group percentage): (ICIQ) International Consultation on Incontinence Questionnaire

| Pelvic floor disorder | Participants [*n* (%)] | | | |
|---|---|---|---|---|
| | Total group (*n* = 1598) | Non-exercisers [*n* = 457 (< 2.5 h/week)] | Exercisers [*n* = 1141 (> 2.5 h/week)] | Between-group difference |
| Urinary incontinence | 1120 (70.1) | 328 (71.8) | 792 (69.4) | *P* = 0.352 |
| Urinary incontinence severity (ICIQ scale):* | | | | *P* = 0.406† |
| slight | 423 (26.5) | 119 (26.0) | 304 (26.6) | |
| moderate | 506 (31.7) | 140 (30.6) | 366 (32.1) | |
| severe | 191 (12.0) | 66 (14.4) | 125 (11.0) | |
| very severe | 12 (0.8) | 4 (0.9) | 8 (0.7) | |
| Anal incontinence: | | | | |
| gas/stool | 769 (48.1), missing (1) | 208 (45.5) | 561 (49.2), missing (1) | *P* = 0.182 |
| marking underwear | 278 (17.3), missing (1) | 78 (17.1) | 198 (17.4), missing (1) | *P* = 0.886 |
| Faecal urgency | 450 (28.2) | 132 (28.9) | 318 (27.9) | *P* = 0.684 |
| Constipation | 289 (18.1) | 99 (21.7) | 190 (16.7) | *P* = 0.019‡ |
| Pelvic organ prolapse | 293 (18.4) | 94 (20.6), missing (1) | 199 (17.4) | *P* = 0.152 |

*ICIQ-UI SF severity index based on Klovning *et al.* (2009): maximum score = 21; slight (1–5), moderate (6–12), severe (13–18) and very severe (19–21).
†All reported with one degree of freedom other than ICIQ severity score with four degrees of freedom and one overall *P*-value.
‡Reached between-group significance, Pearson $\chi^2$ test ($P < 0.05$).

Risk factors associated with UI included ageing, BMI, constipation and parity. Anal incontinence was associated with age, constipation and forceps delivery. Pelvic organ prolapse was associated with hormonal status, constipation and increasing parity (Table 3).

Subdivision of exercise levels based on hours per week: (2.5–6 h, 6–10 h and > 10 h) no significant differences regarding prevalence of UI. Women who exercised > 10 h per week reported fewer incidences of POP (OR = 0.70, 95% CI = 0.42–1.19), but this was not significant ($P = 0.190$). There was, however, increased reporting of AI by those exercising > 10 h per week (adjusted OR = 1.48, 95% CI = 1.04–2.10) (Table 4).

**Table 3.** Adjusted odds ratios (ORs, calculated via binomial logistic regression analysis) for the relationship between pelvic floor symptoms and risk factors: (CI) confidence interval

| | Urinary incontinence | | Pelvic organ prolapse | | Anal incontinence | |
|---|---|---|---|---|---|---|
| Risk factors* | Adjusted OR (95% CI) | *P*-value | Adjusted OR (95% CI) | *P*-value | Adjusted OR (95% CI) | *P*-value |
| Exercise > 2.5 h/week | 1.092 | 0.504 | 1.00 (0.75–1.35) | 0.972 | 1.21 (0.96–1.52) | 0.105 |
| Age (years): | | | | | | |
| 37–50 | 1.97 (1.47–2.63) | < 0.001† | 1.20 (0.80–1.80) | 0.379 | 1.82 (1.04–3.19) | 0.038† |
| 51–65 | 2.10 (1.38–3.18) | < 0.001† | 1.16 (0.69–1.94) | 0.585 | 1.83 (0.92–3.64) | 0.087 |
| > 65 | 2.54 (1.23–5.27) | 0.012† | 1.03 (0.45–0.99) | 0.936 | 3.28 (1.34–8.08) | 0.010† |
| Hormonal effects | 0.99 (0.69–1.42) | 0.965 | 0.66 (0.45–0.99) | 0.044† | 1.49 (0.92–2.41) | 0.109 |
| Body mass index (kg/m$^2$) | 1.07 (1.04–1.10) | < 0.001† | 1.00 (0.97–1.02) | 0.723 | 1.02 (1.00–1.04) | 0.109 |
| Constipation | 1.40 (1.03–1.90) | 0.032† | 1.98 (1.44–2.73) | < 0.001† | 1.32 (1.02–1.72) | 0.037† |
| Parity: | | | | | | |
| 1 | 1.71 (1.21–2.42) | 0.003† | 5.45 (3.14–9.46) | < 0.001† | 0.79 (0.57–1.10) | 0.159 |
| 2 | 1.89 (1.41–2.52) | < 0.001† | 7.33 (4.43–12.13) | < 0.001† | 0.87 (0.67–1.14) | 0.317 |
| 3 | 2.32 (1.50–3.59) | < 0.001† | 8.94 (5.01–15.95) | < 0.001† | 0.93 (0.64–1.35) | 0.697 |
| 4+ | 1.95 (0.92–4.12) | 0.081 | 14.02 (6.43–30.57) | < 0.001† | 1.30 (0.68–2.49) | 0.430 |
| forceps | 1.16 (0.80–1.68) | 0.443 | 1.27 (0.90–1.79) | 0.182 | 1.58 (1.16–2.16) | 0.004† |

*Risk factors: age (years, 18–36-year-old group as reference); hormonal effects (premenopausal group as reference); body mass index; constipation (no straining to defecate as reference); parity (nulliparous as reference); forceps delivery (non-forceps delivery as reference); and exercise group (exercise levels < 2.5 h a week as reference group).
†Reached significance in regression analysis. Adjusted for all risk factors noted.

**Table 4.** Adjusted odds ratios (ORs) to indicate any relationship between levels of exercise and pelvic floor symptoms: (CI) confidence interval

| | Urinary incontinence | | Pelvic organ prolapse | | Anal incontinence | |
|---|---|---|---|---|---|---|
| Level of exercise (h/week)* | Adjusted OR (95% CI) | *P*-value | Adjusted OR (95% CI) | *P*-value | Adjusted OR (95% CI) | *P*-value |
| 2.5–6 | 1.09 (0.82–1.44) | 0.550 | 1.06 (0.77–1.46) | 0.716 | 1.14 (0.89–1.47) | 0.291 |
| 6–10 | 1.23 (0.87–1.74) | 0.238 | 1.06 (0.70–1.58) | 0.790 | 1.22 (0.90–1.65) | 0.211 |
| > 10 | 0.92 (0.63–1.35) | 0.660 | 0.70 (0.42–1.19) | 0.190 | 1.48 (1.04–2.10) | 0.031† |

*Non-exercisers as the reference group and adjusted for all risk factors as in Table 3.
†Reached significance in regression analysis.

**Table 5.** Adjusted odds ratios (ORs) for the relationship between types of exercise and pelvic floor symptoms: (CI) confidence interval

| | Urinary incontinence | | Pelvic organ prolapse | | Anal incontinence | |
|---|---|---|---|---|---|---|
| Type of exercise | Adjusted OR (95% CI) | *P*-value | Adjusted OR (95% CI) | *P*-value | Adjusted OR (95% CI) | *P*-value |
| Both low- and high-impact | 0.78 (0.57–1.09) | 0.143 | 0.73 (0.49–1.09) | 0.122 | 1.18 (0.88–1.59) | 0.268 |
| High-impact only | 0.84 (0.59–1.20) | 0.342 | 0.92 (0.60–1.42) | 0.715 | 0.86 (0.62–1.19) | 0.374 |

Further investigation to account for the potential effects of exercise involving impact only as opposed to non-impact sport revealed no significant differences in levels of PFD (Table 5).

*Pelvic floor muscle exercises and treatments.* Pelvic floor muscle exercises were performed regularly by only 646 (40%) participants.

Of those reporting any PFD, only 450 out of 1319 (34%) had sought professional help. Those with symptoms were no more or less likely to exercise their pelvic floors.

*Responses to open question.* In the final section, 537 participants made comments. These are reported in detail elsewhere (Campbell *et al.* 2023, pp. 29–37), but the present authors report, in brief, key illustrative quotations regarding the impact of symptoms on access to sport and treatments to manage symptoms.

*Pelvic floor symptoms impacting access to sport.* Often participants commented that their pelvic floor symptoms were the reason why they could no longer take part in sport and exercise:

> "I would love to exercise to lose weight, but it is impossible with these bladder issues . . . it's so frustrating"

> ". . .[M]y exercise intensity and frequency have changed since having children due to leakage/prolapse symptoms. Before kids, my exercise intensity was high and 6 days per week. Now, I don't engage in high-intensity exercise anymore. . ."

Many commented on the negative effects of this, ranging from ensuring that their bladder had been emptied before leaving the house to great distress:

> "I feel like I should always empty my bladder before I leave the house, gym, work, etc. to avoid a panic when I need to urinate."

> "It's impacted my life – I can't run anymore. . . No one gives a damn because it's only women."

*Treatment.* Some commented on treatments that they had attempted to seek or been offered, and many suggested that PFMEs did help:

> "Doing daily regular sustained [PFMEs] has greatly improved my symptoms."

However, others found that taking part in sport had helped:

> "I started to include weight training . . . and feel that has helped my pelvic floor enormously."

## Discussion

The objectives of the present survey were to determine levels of PFD in women who exercised at or above recommended guidelines for healthy living, and in those who did not, and to identify any correlation between exercising recreationally and the incidence of PFD, as previously noted in literature on elite athletes (Araujo *et al.* 2015; Almeida *et al.* 2016; Carvalhais *et al.* 2018; Skaug *et al.* 2022).

All levels of PFD reported were high compared with other studies: UI was reported by 40% of women in a 2015 UK survey (Cooper *et al.* 2015) compared with 70% of the present participants, and AI was reported by only 14% of women in a US epidemiological survey (Gabra *et al.* 2022) compared with 48% here. However, a recent study investigating the long-term effects of sphincter injuries at birth on AI reported a 60% prevalence of AI in the control group, i.e. those without sphincter injury (Everist *et al.* 2023), and this level was similar to that found in a group of young nulliparous women (Almeida *et al.* 2016). Levels of POP again appear to be greater than those reported in the US epidemiological study (Gabra *et al.* 2022), but in another recent Internet-based survey, 14% of participants reported POP (Forner *et al.* 2020) compared with 18% of the present respondents. It is likely that there will be some selection bias in an Internet survey since women with an interest are more likely to take part, despite advertisements aiming to recruit *all* women. However, it may be that, because pelvic health symptoms are increasingly being discussed more openly in the media, women are becoming more confident about sharing information regarding these symptoms.

The present authors found no significant associations between taking part in recreational sport and exercise and PFD other than a small increase in the number of women reporting AI when exercising for more than 10 h per week. However, this should be interpreted with caution given the low numbers of women exercising at higher levels in this survey. It is important to note that many previous studies reporting increased levels of PFD in athletes have investigated the elite population (Carvalhais *et al.* 2018), whereas other investigations that have noted significantly higher levels of UI included only young nulliparous women, without the increased extra risks associated with parity and/or assisted delivery in their sedentary cohort (Almeida *et al.* 2016). Athletes in the latter study reported training on average for 19 h per week, whereas the majority of the present exercisers were exercising for less than 10 h per week, and a positive association has been reported between volume of physical activity and the frequency of UI (Alves *et al.* 2017). However, a previous study also found no significant correlation between UI or POP and exercise, and the only significant correlation reported was between AI and sport (Carvalho *et al.* 2020).

The demands of elite-level competition dictate that reducing training levels or modifying load is rarely an option unless there is illness or injury. It is, therefore, likely that elite athletes, many of whom have never mentioned their symptoms to anyone (Carls *et al.* 2007), would not alter their sport or training levels as a result of PFD. In the case of the recreational athletes in the present survey, however, comments suggested that women often modified their sports to include lower-impact activities or reduced the level of exercise that they took part in altogether. This, combined with the lower volume of exercise performed by most of the present exercisers, may explain the differences in the results. However, it should also be noted that, since the majority of exercisers in

the present survey have been doing so for over 5 years, there is little in this study to suggest that recreational sport at these levels is a specific risk to the pelvic floor.

Finally, the majority of those who reported PFD here had not sought professional help, despite comments suggesting that PFD caused distress. This is recognized, and has previously been reported in other studies on both athletes (Carls *et al.* 2007) and the general population (Cooper *et al.* 2015).

A major strength of Internet-based surveys is the ability to recruit large numbers of participants from a spread of geographical locations. Moreover, although self-reporting of symptoms may be less accurate than using objective measures such as pad tests to detect incontinence or vaginal examination to diagnose POP, this is mitigated by the use of validated questionnaires to predict symptoms.

There are, however, associated limitations, not the least of which is the possibility of selection bias, since those affected by the criteria being investigated are most likely to take part, which may increase prevalence levels. In addition, although advertisements asked *all* women to participate, the only inclusion criteria were to be adult and female; this could mean that some were pregnant or possessed disabilities that could have an impact on their pelvic floor function. Furthermore, although the present authors aimed to recruit a diverse population, the majority of participants were educated to degree level or above. It is then even more surprising that most symptomatic participants had never sought professional help.

## Conclusion

Overall levels of PFD within the present survey were high, but there was no association between recreational exercise and the rates of PFD reported. Further longitudinal studies may help to investigate any long-term risks of recreational exercise to pelvic health. However, based on the results of this survey and the multiple health benefits associated with taking part in regular sport and exercise, women and health professionals should be cautious when extrapolating the risks to the pelvic floor associated with elite sport to recreational exercisers.

## Supplementary information

The online version of the present paper contains supplementary material: https://doi.org/10.1007/s00192-023-05548-8

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## Authors' contributions

All authors were involved in the design of the survey, protocol and authorship of the article: (K.G.C.) protocol development, data collection, management and analysis, and manuscript writing; (M.E.B.) protocol development, data collection, management and manuscript writing; and (A.D.) protocol development, data collection, management and manuscript writing.

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## Declarations

### *Ethical approval*

This study was approved by the Research Ethics Committee of the Faculty of Medicine and Health Sciences, University of Nottingham (FMHS 501-0322). All participants gave electronic consent before progressing to data collection. Data were anonymized at source, and no individual Internet Protocol addresses were retained.

### *Conflicts of interest*

None.

### *Data sharing*

A summary of the data set generated and analysed during the present study may be available from the corresponding author on reasonable request.

### *Public and patient involvement*

A patient representative, who has experienced PFD and its impact on her sport, was involved

as a member of the study steering group from its inception, and took an equal part in all aspects of the design of the survey, study protocol, and decisions regarding advertising and analysis. She will continue to be involved as a member of the steering group to decide on potential ways to disseminate the results to the public going forward. Furthermore, local women were recruited to pilot initial versions of the survey to identify any issues with wording and content. The final version was modified based on their feedback.



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