

"This is the peer reviewed version of the following article: currently in press: Brown, N., Burnett, E., Scurr, J. *The Breast Journal*, Is breast pain greater in active females compared to the general population in the UK? which has been published in final form at [Link to final article using the DOI]. This article may be used for non-commercial purposes in accordance with [Wiley Terms and Conditions for Self-Archiving](#)."

## Is breast pain greater in active females compared to the general population in the UK?

Nicola Brown<sup>1,2</sup>, Emma Burnett<sup>2</sup>, Joanna Scurr<sup>2</sup>.

<sup>1</sup>School of Sport, Health & Applied Science, St Mary's University,  
Waldegrave Rd, Twickenham, TW1 4SX, UK

<sup>2</sup>Research Group in Breast Health, University of Portsmouth, Cambridge Rd,  
Portsmouth, UK.

### Nicola Brown (Corresponding Author):

School of Sport, Health & Applied Science, St Mary's University,  
Waldegrave Rd, Twickenham, TW1 4SX, UK

T: +44(0)20 8240 2321

F: +44(0)20 8240 4212

E: [nicola.brown@smuc.ac.uk](mailto:nicola.brown@smuc.ac.uk)

**Running Title:** Breast pain in active females and general population

**Keywords:** breast pain, mastalgia, sports bra, breast support, physical activity

**Abstract Word count:** 296

**Word Count:** 3433 (excluding abstract, tables, figures and references)

## **ABSTRACT**

Cyclic and non-cyclic breast pain effect up to 60% of women, decreasing quality of life. Additionally, exercise-induced breast pain (thought to be caused by tension on breast skin and fascia during breast motion) is reported in up to 72% of exercising females. These forms of breast pain may be experienced concurrently; therefore it is hypothesised that this compound effect may cause higher breast pain prevalence and severity in active populations. This study investigated the prevalence and severity of breast pain in an active cohort, compared to a random cohort. A random sample of 234 UK females completed a self-administered survey reporting physical activity history, prevalence, severity and frequency of breast pain, breast support habits, bra satisfaction, occurrence of bra-related issues, and demographics. This sample was age-matched to a sample of active females (n = 234) from a cross-sectional survey of 1285 female marathon runners who completed a similar survey. Breast pain prevalence was significantly lower in the active cohort (32.1%) compared to the random cohort (43.6%), however, the severity and frequency of breast pain was similar in both cohorts. The active cohort undertook significantly more physical activity, were lighter, had greater nulliparous rates, greater adherence to sports bra use, but less adherence to professional bra fitting. With lower breast pain rates in the active cohort the hypothesis of a compound effect of multiple forms of breast pain causing an increase in prevalence and severity is rejected. The lower prevalence may be related to increased physical activity, reduced body mass and increased sports bra use. Sports bra use is already recommended in the literature for symptomatic women, however, this is the first study to report that increased physical activity and weight loss may be an appropriate life style choice to reduce the prevalence of breast pain.

## **1. INTRODUCTION**

Traditionally two categories of breast pain (mastalgia) have been reported in the clinical literature, cyclic; where breast pain occurs for two or more days during the luteal phase of each menstrual cycle (1), and non-cyclic; which is characterised by a random pattern of pain (2). In a review of breast pain, Ader and Shriver (3) reported a prevalence of 45% to 60% for breast pain in UK cohorts. Breast pain can be severe enough to cause some women to seek medical intervention, in fact Tavaf-Motamen, Ader and Browne (4) reported breast pain as the most common reason for attendance in breast clinics or centres. Cyclic breast pain is known to account for approximately two thirds of breast pain cases in speciality clinics, with non-cyclic breast pain accounting for the remaining one third (5). More recently physical activity research has reported an additional form of breast pain referred to as movement- or exercise-induced breast pain (6,7). Exercise-induced breast pain is associated with the motion of the breast (8) and was reported in up to 72% of exercising females (9). With only weak natural support within the breast (10) exercise-induced breast pain is thought to be caused by tension on both the skin and fascia of the breast (8).

Breast biomechanics research has reported that increased levels of exercise are linked to increased breast pain (8), particularly when undertaken wearing inappropriate breast support (9) and for larger breasted women (11). Clinical breast pain and exercise-induced breast pain may occur concurrently; the compound effect of these conditions could lead to increased levels of breast pain in active populations or could be a deterrent to physical activity for some women.

Despite the theory that the compound effect of clinical and exercise-induced breast pain could lead to an increase in breast pain prevalence in active populations, it is interesting to note that the only research to investigate this area actually reported a lower prevalence of breast pain (32%) in 1285 female marathon runners (12) compared to the previously reported data for the general population (45% to 60%) (3). The lower prevalence of breast pain in female marathon runners could be due to the marathon cohort having smaller breasts than the general population, a higher engagement in sports bra use, an increased knowledge of breast support, a reduction in bra issues, or women with severe breast pain self-selecting out of this type of activity. Finally, could it be that physical activity ultimately reduces breast pain symptoms.

Positive benefits of exercise for chronic pain sufferers have been reported elsewhere in the literature, with exercise reducing the intensity of pain in patients with lower back pain (13); however, a comparison of breast pain prevalence and severity between an active population and a normal population has yet to be considered. The results of such an investigation may help us understand whether physical activity could be an appropriate intervention for women with breast pain. Breast pain can be severe enough to affect a woman's quality of life (14) and therefore interventions that offer relief from breast pain are important to investigate.

Pharmacological interventions for breast pain, whilst effective, have demonstrated side effects which deter their use by practitioners (15, 16). Instead, most research today recommends non-pharmacological interventions including; Evening Primrose Oil, vitamins, changing diet/fluid intake, relaxation therapy, reducing caffeine intake

and using an appropriately fitted, supportive bra (17, 18). The influence of an active life style on the prevalence and severity of breast pain has yet to be considered.

Therefore, the aim of this study is to investigate the prevalence and severity of breast pain in an active population, compared to a random sample of the female population in the UK. To understand the factors that may influence any differences in breast pain prevalence or severity, this study also aimed to compare breast and bra history between the two populations. Due to the potential compound effect of clinical and exercise-induced breast pain it was hypothesised that the active population would demonstrate a higher prevalence and severity of breast pain compared to a random sample of the female population in the UK.

## **2. METHOD**

### **2.1 Study population and study design**

This was a survey based study administered on two cohorts of women. Surveys were approved by relevant institutional ethics committees, all participants gave informed consent and all data were anonymous. The surveys administered to both cohorts included the same questions. The first cohort aimed to capture a random sample of females. This was completed via a self-administered survey mailed to a convenience sample of 274 females, with the majority being administered in the Portsmouth and Southampton local areas, of which 250 surveys were returned, completed or partially completed (response rate of 91%). Surveys with missing responses were deleted list wise ( $n = 16$ ) resulting in a final sample size of 234. The second cohort aimed to capture an active cohort of females. This was completed using a cross-sectional survey of 1397 female marathon runners conducted during

the registration period of the 2012 London Marathon, of which there were 1285 fully completed surveys. Both cohorts were stratified by age and frequency matching was used to select cases from the active cohort with an identical age distribution to the random cohort. We were able to select 77 age matched active cases in the age bracket 18 to 24 years, 48 cases in the age bracket 25 to 29 years, with the remaining age brackets (30 to 34, 35 to 39, 40 to 44, 45 to 49, 50 to 54 years), each containing between 14 and 20 cases. In the final age category, 60 to 64 years we were able to select 7 cases. For further details on the marathon study design and data handling procedures, the reader is referred to Brown, White, Brasher and Scurr (12).

## **2.2 Survey measures**

### **2.2.1 Demographic characteristics and breast health history**

Age (years) was categorised into nine age brackets (previously described). Five body mass groups were categorised as < 54 kg, 55 to 64 kg, 65 to 74 kg, 75 to 84 kg, and > 85 kg. There were seven breast health related questions that were dichotomised into yes or no categories these were; whether participants had given birth, breastfed, had any surgical procedures to the breast, had breast cancer or used oral contraceptives. Menopausal status was categorised as pre-, mid- or post-menopausal. Underband and breast cup size were self-reported.

### **2.2.2 Breast pain**

The prevalence and severity of breast pain was assessed using an adaptation of the McGill Pain Questionnaire (19). Participants were asked if they experienced breast pain (yes or no), how long they had experienced breast pain for (years, months) and

whether they perceived their breast pain to be related to their menstrual cycle (yes, no, or sometimes). The severity of pain was assessed on a visual analogue scale (where 0 corresponded to 'no pain' and 10 'worst possible pain'). Five-point Likert scales were used to identify the intensity of breast pain (ranging from mild to excruciating), the frequency of breast pain (ranging from hourly to every two to three months), and how often breast pain was experienced in moderate and vigorous physical activity (ranging from 'never' to 'always').

### **2.2.3 Breast support habits and bra fit issues**

Participants were asked to rate their frequency of sports bra use and frequency of bra-related issues experienced during physical activity using a five-point Likert scale with responses ranging from 'never' to 'always'. Likewise, to assess perceived knowledge of breast health issues such as bra fit, appropriate breast support and breast pain, participants were provided with a five-point Likert scale (extremely poor, below average, average, above average, excellent). To assess when participants had last had a professional bra fit, a six-point Likert scale was used (within last month, within last 3 months, within last 6 months, within last year, over a year ago, never fitted).

### **2.2.4 Physical activity participation**

Physical activity participation was assessed using questions from the Global Physical Activity Questionnaire Analysis Guide (20). These included how many days in a typical week participants participated in moderate- and vigorous-intensity activities for more than 10 minutes continuously and how much time on a typical day they spent doing these activities. Moderate intensity activities were categorised as

those requiring moderate physical effort and causing small increases in breathing or heart rate and vigorous intensity activities were categorised as those requiring hard physical effort and large increases in breathing or heart rate (20).

### **2.3 Data handling and statistical analysis**

Participants' demographics and physical activity history were summarised using descriptive measures. Continuous variables were expressed as mean ( $\pm$  standard deviation) and categorical variables were expressed as a percentage. Inferential analyses were performed using Predictive Analytic Software at the 0.05 level of significance. Differences in continuous and ordinal variables between the two cohorts were assessed using independent t-tests and Mann Whitney U tests, respectively. Chi-square analysis was used to assess categorical variables. To meet Chi-square assumptions (21), breast size was grouped into small ( $\leq$  C cup size; random, n = 128; active, n = 142) and large ( $\geq$  D cup size; random, n = 106, active, n = 92) (11, 22). Additionally, the frequency of breast pain groups of 'hourly' and 'daily' were condensed to one group to create four frequency groups, and the severity of breast pain groups of 'horrible' and 'excruciating' were condensed to one group to create four severity groups.

## **3. RESULTS**

The descriptive characteristics of the two study cohorts are outlined in Table 1. Females in the active cohort reported participating in significantly more moderate and vigorous activity sessions per week than the random cohort (moderate: t = 5.753, p < 0.001; vigorous: t = 8.214, p < 0.001) and exercising for significantly longer durations (moderate: t = 2.596, p = 0.010; vigorous: t = 4.006, p < 0.001). The

random cohort were significantly heavier than the active cohort ( $\chi^2 = 33.815$ ,  $p < 0.001$ ) and a significantly higher proportion of the random cohort had given birth (38.5%) compared to the active cohort (29.5%) ( $\chi^2 = 4.201$ ,  $p = 0.040$ ). However, of those that had given birth, a significantly higher proportion of the active cohort had breast fed (94.1%) compared to the random cohort (79.8%) ( $\chi^2 = 6.581$ ,  $p = 0.010$ ). In both cohorts a very small percentage of women had previously had breast cancer or a surgical procedure to the breast and approximately half of women in each cohort reported taking a contraceptive pill, with no significant differences in these variables between groups.

\*Insert Table 1 here\*

Breast cup size ranged from A cup to G cup (mode cup size C) in the random cohort and AA cup to H cup (mode cup size B) in the active cohort. In both cohorts participants breast cup size was positively skewed (Fig. 1). There was no significant difference in the number of women with small or large breasts between the two cohorts ( $\chi^2 = 1.716$ ,  $p = 0.190$ ).

\*Insert Figure 1 here\*

### 3.1 Prevalence, severity and frequency of breast pain

The prevalence of breast pain was significantly higher in females from the random cohort compared to females from the active cohort (43.6 % and 32.1%, respectively;  $\chi^2 = 6.624$ ,  $p = 0.010$ ) (Fig. 2). In both cohorts the prevalence of breast pain was

13.0% higher in larger-breasted females compared to smaller-breasted females (random:  $\chi^2 = 4.262$ ,  $p = 0.039$ ; active:  $\chi^2 = 4.642$ ,  $p = 0.031$ ). Furthermore, the prevalence of breast pain was significantly higher in nulliparous women in both cohorts (random:  $\chi^2 = 9.262$ ,  $p = 0.002$ ; active:  $\chi^2 = 4.778$ ,  $p = 0.029$ ). Over half (51.4%) of nulliparous women in the random cohort experienced breast pain compared to 31.1% of women who had given birth. In the active cohort 36.4% of nulliparous women experienced breast pain compared to 21.7% of women who had given birth (Fig. 2).

\*Insert Figure 2 here\*

The mean severity of breast pain reported in the random cohort (3.7 out of 10  $\pm$  1.9) and in the active cohort (3.9 out of 10  $\pm$  2.1) did not differ significantly between the two cohorts ( $Z = -0.417$ ,  $p = 0.676$ ). The majority of participants in the random and active cohort reported experiencing breast pain monthly (53.0% and 40.0%, respectively) and described the severity of breast pain as discomforting (57.6% and 54.8%, respectively) (Table 2) with no significant differences between cohorts for the frequency ( $\chi^2 = 2.984$ ,  $p = 0.394$ ), or severity ( $\chi^2 = 6.529$ ,  $p = 0.089$ ) of breast pain.

\*Insert Table 2 here\*

### 3.2 Breast support habits and bra fit issues

Sports bra use during physical activity was significantly higher in the active cohort compared to the random cohort ( $\chi^2 = 107.840$ ,  $p < 0.001$ ) with 77.8% of the active cohort reporting that they always wore a sports bra during physical activity compared

to just 32.1% in the random cohort. Only 5.1% of the active cohort reported never wearing a sports bra compared to 31.2% in the random cohort. Across both cohorts, the most common bra issue experienced was shoulder straps digging in, with 28.6% of all participants sometimes experiencing this bra issue and a further 8.5% often experiencing this bra issue (Table 3). Rubbing and chaffing, and underwire digging into the skin were bra issues experienced significantly more by the active cohort compared to the random cohort ( $\chi^2 = 17.826$ ,  $p < 0.001$  and  $\chi^2 = 15.903$ ,  $p = 0.001$ , respectively) (Table 3). In contrast, upper body pain (as a result of bra use) was experienced significantly more by the random cohort ( $\chi^2 = 36.637$ ,  $p < 0.001$ ).

\*Insert Table 3 here\*

The uptake of professional bra fitting services was significantly higher in the random cohort compared to the active cohort ( $\chi^2 = 80.859$ ,  $p < 0.001$ ) (Fig. 3). One fifth (20%) of the random cohort reported using professional bra fitting services within the last month compared to just 4% in the active cohort. Additionally, 20% of the active cohort had never had a professional bra fit. Breast size was significantly related to the uptake of professional fitting services in both the random cohort ( $\chi^2 = 8.293$ ,  $p < 0.081$ ) and the active cohort ( $\chi^2 = 31.429$ ,  $p < 0.001$ ). For both cohorts, the time that had elapsed since the last professional fitting decreased as cup size increased, and a higher proportion of participants with smaller breasts reported never being fitted compared to participants with larger breasts.

\*Insert Figure 3 here\*

The random and active cohorts reported similar levels of breast health knowledge, with the majority of participants rating their knowledge as average (52% and 60%, respectively;  $\chi^2 = 5.281$ ,  $p > 0.260$ ). Breast health knowledge was not related to breast size in either cohort (random: ( $\chi^2 = 9.160$ ,  $p = 0.057$ ; active: ( $\chi^2 = 1.493$ ,  $p = 0.828$ ).

#### **4. DISCUSSION**

The aim of this study was to investigate the prevalence and severity of breast pain in an active population, compared to a random sample of UK females. By design, physical activity levels were significantly higher in the active cohort compared to the random cohort. However, the results indicate that women from both cohorts are participating in enough physical activity to meet recommended guidelines of at least 150 minute per week (23). The severity and frequency of breast pain did not differ between the two cohorts, however the prevalence of breast pain was significantly lower in the active cohort (32.1%) compared to the random cohort (43.6%). Despite the theory that the active cohort may experience a compound effect of clinical and exercise-induced breast pain, leading to higher breast pain prevalence and severity, the results of this study reject this hypothesis. The volume of breast pain sufferers in both populations is supported by previous research, with Brown et al. (12) reporting 32% of the full cohort of marathon runners ( $n=1285$ ) reporting breast pain and Ader and Shiver (3) reporting between 45% and 60% in a more general population.

To understand factors that may influence the lower prevalence of breast pain in the active compared to the random cohort, participants breast and bra history were considered. Active participants reported no difference in breast surgery rates,

contraceptive medication or breast cup size when compared to the random cohort. However, those in the active cohort undertook significantly more physical activity, were lighter, had a greater nulliparous rate, a greater adherence to sports bra use, but less adherence to professional bra fitting.

Considering each of these factors; increases in physical activity have previously been reported to reduce chronic pain symptoms suggesting that increased levels of physical activity may be an effective life style choice to reduce the occurrence of breast pain. As this is not an intervention study, this result should be verified with a randomised control trial that prescribes physical activity for symptomatic women. As expected, the active cohort had a reduced body mass compared to the random population. Previous research has shown reduced breast pain symptoms in those with a lower body mass index (12), however this is the first study that reports a potential positive effect of reduced body mass on breast pain prevalence. Whilst reductions in body mass may accompany an increase in physical activity, further research is warranted to understand whether body mass is a causal factor for breast pain. Despite the active cohort reporting increased nulliparous rates compared to the random cohort, previous research has reported that hormone events such as pregnancy may actually reduce breast pain (2, 18). Furthermore, Davies, Gateley, Miers and Mansel (5) found that following child birth 8% and 10% of participants were relieved from cyclic and non-cyclic breast pain, respectively. Additionally, combining the cohorts in this study showed that the prevalence of breast pain was significantly lower in women who had given birth compared to nulliparous women. This suggests that the greater occurrence of nulliparous women in the active cohort is not associated with the lower breast pain prevalence rates.

Finally, increases in the level of breast support are known to reduce both exercise-induced breast pain (7, 8) and clinical breast pain (25), therefore the increased adherence to sports bra use in the active cohort may contribute to the reduced prevalence of breast pain. This finding also supports previous clinical recommendations for the use of supportive bras as a treatment for breast pain. This finding is despite the reduced adherence to professional bra fitting.

Additional findings from both cohorts in this study show that breast pain was associated with bra cup size, with larger breasted women ( $\geq$  D cup) in both cohorts reporting a higher prevalence of breast pain than their smaller breasted counterparts. This is concurrent with the findings of Brown et al. (12) who found larger breasted women had a higher prevalence of breast pain and reinforces the idea that breast pain may be associated with bra size. As expected the two cohorts experienced differences in bra issues during physical activity. Rubbing and chafing, and bra underwire digging in were experienced more in the active cohort. The higher prevalence of these bra issues in the active cohort may be related to their lack of engagement in professional bra fitting or to the duration of marathon running and the subsequent demands that this places on the bra. Poorly fitting bras have been associated with negative health issues including breast pain, back pain and poor posture (25) and therefore it is imperative that bra fitting services are promoted.

## **5. CONCLUSION**

In conclusion, despite the potential for a compound effect of clinical breast pain and exercise-induced breast pain, an active female population demonstrated a lower

prevalence of breast pain compared to a random sample from the general female population in the UK. As well as increased levels of physical activity, this sample were lighter, had greater nulliparous rates and engaged more in sports bra use, but less in professional bra fitting services. Further investigation of breast and bra history to understand the reduce breast pain prevalence in the active cohort ruled out nulliparity as a factor associated with lower prevalence's of breast pain as when considered over the whole population in this study those who had given birth demonstrated a lower prevalence of breast pain. Of the remaining factors, sports bra use as a treatment for breast pain sufferers has been previously identified and is therefore supported by these findings. However, this is the first study to identify a link in physical activity participation and body mass to reduced breast pain prevalence. This result suggests that physical activity and weight loss may be an effective life style choice for women to reduce the prevalence of breast pain. Before these recommendations are made to symptomatic women, an intervention study investigating the influence of physical activity and weight loss on the prevalence of breast pain is warranted based on the findings of this study.

## REFERENCES

1. Ader DN, Shriver CD. Cyclical mastalgia; prevalence and impact in an outpatient breast clinic sample. *J Am Coll Surg* 1997; 185:466-470.
2. Mansel RE. ABC of Breast Diseases: Breast Pain. *BMJ* 1994; 309:866-868.
3. Ader DN, Shriver CD. Update on Clinical and Research Issues in Cyclical Mastalgia. *Breast J* 1998; 4:25-32.
4. Tavaf-Motamen H, Ader DN, Browne MW, Shriver CD. Clinical evaluation of mastalgia. *Arch Surg-Chicago* 1998; 133:211-214.
5. Davies EL, Gateley CA, Miers M, Mansel RE. A long term course of mastalgia. *JRSM open* 1998; 91:462-464.
6. Haake S, Milligan A, Scurr, J. Can measures of strain and acceleration be used to predict breast discomfort during running? *Proc Inst Mech Eng P J Sports Eng Technol* 2012; 227:209-216.
7. Scurr J, White J, Hedger W. The effect of breast support on the kinematics of the breast during the running gait cycle. *J Sports Sci* 2010; 28:1103-1109.
8. Mason BR, Page K, Fallon K. An analysis of movement and discomfort of the females breast during exercise and the effects of breasts support in three cases. *J Sci Med Sport* 1999; 2:134-144.
9. Gehlsen G, Albohm M. Evaluation of sports bras. *Phys Sports Med* 1980; 8:89-96.
10. Gefen A, Dilmoney B. Mechanics of the normal woman's breast. *Technol Health Care* 2007;15:259-71.
11. Lorentzen D, Lawson L. Selected sports bras: A biomechanical analysis of breast motion while jogging. *Physician Sports Med*, 1987; 15:128-139.

12. Brown N, White J, Brasher A, Scurr J. The experience of breast pain (mastalgia) in female runners of the 2012 London Marathon and its effect on exercise behaviour. *Br J Sports Med* 2014; 48:320-325.
13. Frost H, Klaber Moffett JA, Moser JS, Fairbank JCT. Randomised controlled trial for evaluation of fitness programme for patients with chronic low back pain. *BMJ* 1995; 310:151-154.
14. Ader DN, Browne MW. Prevalence and impact of cyclic mastalgia in a United States clinic-based sample. *Am J Obstet Gynecol* 1997; 177:126-132.
15. Brennan M, Houssami N, French J. Management of benign breast conditions. *Aust Fam Physician* 2005; 34:143-145.
16. Cairncross L. Mastalgia. *CME* 2010; 28:504-506.
17. Fox H, Walker LG, Ah-See AK, Eremin O. Are patients with mastalgia anxious, and does relaxation therapy help? *Breast* 1997; 6:138-142.
18. Smith RL, Pruthi S, Fitzpatrick, LA. Evaluation and management of breast pain. *Mayo Clin Proc* 2004; 79:353-372.
19. Melzack R. The McGill Pain Questionnaire: Major properties and Scoring methods. *Pain* 1975; 1:277-299.
20. World Health Organisation. *Global Physical Activity Questionnaire (GPAQ) Analysis Guide*. 2005 [available at: [http://www.who.int/chp/steps/resources/GPAQ\\_Analysis\\_Guide.pdf](http://www.who.int/chp/steps/resources/GPAQ_Analysis_Guide.pdf)].
21. Field A. *Discovering statistics using SPSS 3<sup>rd</sup> edn*. London, UK: Sage Publications Ltd, 2009.
22. Dundas KL, Atyeo J, Cox J. What is a large breast? Measuring and categorizing breast size for tangential breast radiation therapy. *Australas Radiol* 2007; 51:589–593.

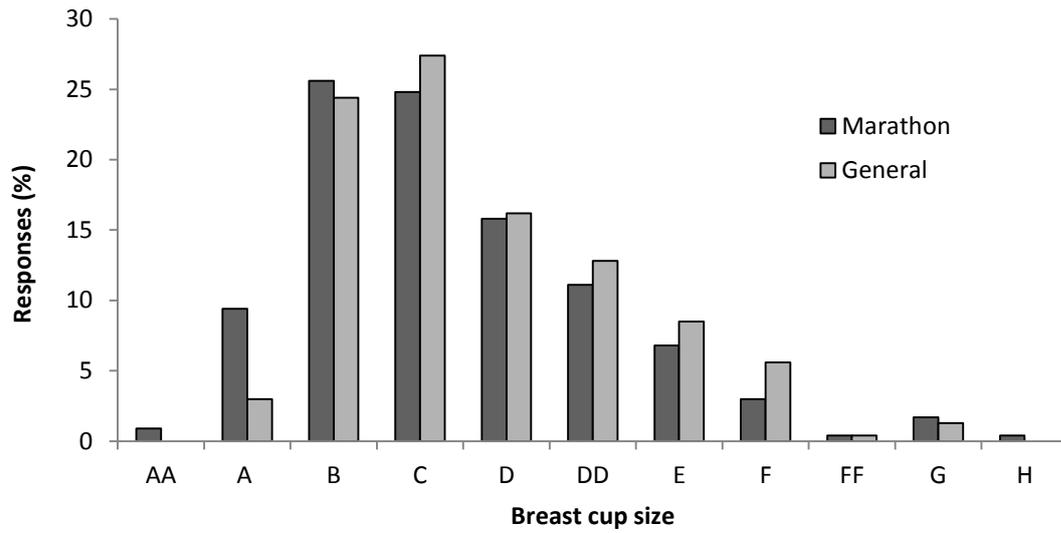
23. Department of Health. *Physical Activity Guidelines for Adults (19-64 years)*. 2011. [available at: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/213740/dh\\_128145.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213740/dh_128145.pdf)].
24. Hadi MSA. Sports brassiere: Is it a solution for mastalgia? *Breast J* 2000; 6:407-409.
25. McGhee DE, Steele JR. Optimising breast support in female patients through correct bra fit. A cross sectional study. *J Sci Med Sport* 2010; 13:568-572.

Post print

**Table 1.** Descriptive characteristics of the random (n = 234), active (n = 234) and total population (n = 468).

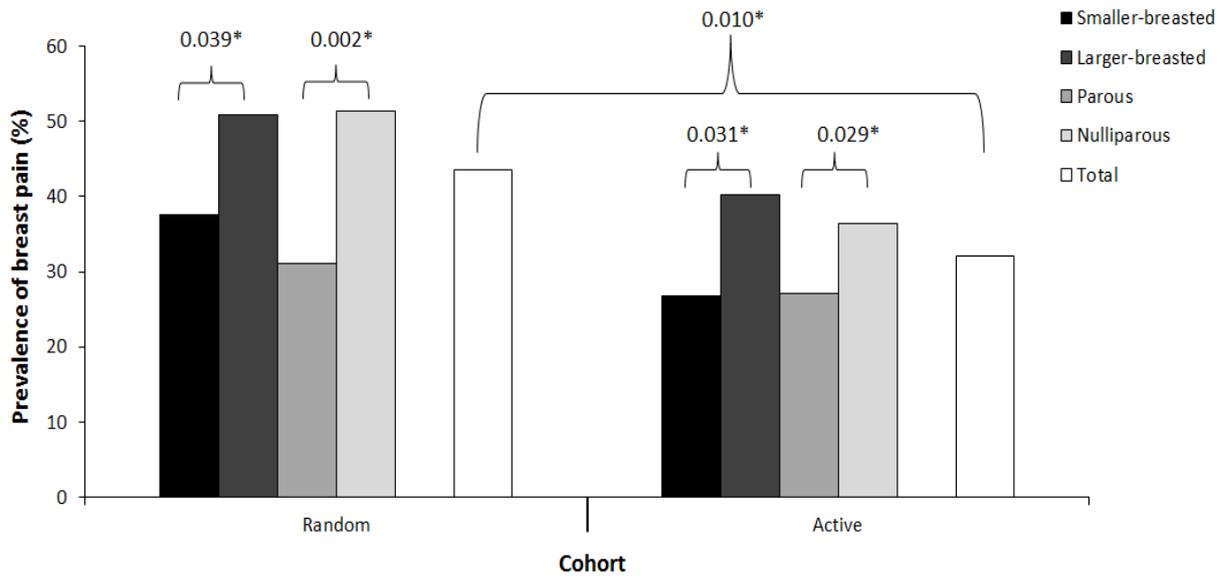
	Random	Active	Total Population	P
<b>Physical Activity (days per week)</b>				
Moderate	2.9 ± 2.3	3.9 ± 1.6	3.4 ± 2.0	< 0.001*
Vigorous	2.2 ± 1.9	2.9 ± 1.7	2.6 ± 1.9	< 0.001*
<b>Activity Duration (mins per session)</b>				
Moderate	62 ± 71	78 ± 58	70 ± 65	0.010*
Vigorous	48 ± 79	74 ± 57	61 ± 70	< 0.001*
<b>Body mass (kg)</b>				
< 54	14.5%	15.0%	14.7%	
55 to 64	32.5%	49.1%	40.8%	
65 to 74	24.8%	26.9%	25.9%	< 0.001*
75 to 84	18.4%	7.7%	13.0%	
> 85	9.8%	1.3%	5.6%	
<b>Menopausal status</b>				
Pre	77.5%	68.4%	72.9%	
Mid	9.7%	18.4%	14.1%	0.023*
Post	12.8%	13.2%	13.0%	
<b>Given birth</b>				
Yes	38.5%	29.5%	34.0%	
No	61.5%	70.5%	66.0%	0.040*
<b>Breastfed (if applicable)</b>				
Yes	79.8%	94.1%	86.0%	
No	20.2%	5.9%	14.0%	0.010*
<b>Had breast surgery</b>				
Yes	3.1%	4.3%	3.7%	
No	96.9%	95.7%	95.7%	0.180
<b>Had breast Cancer</b>				
Yes	1.3%	0.4%	0.9%	
No	98.7%	99.6%	99.1%	0.083
<b>Take a contraceptive</b>				
Yes	50.9%	51.5%	51.2%	
No	49.1%	48.5%	48.8%	0.884

\*denotes significant difference between cohorts



**Figure 1.** Percentage distribution of participants self-reported breast cup size from the random (n = 234) and active (n = 234) cohorts.

Post print



**Figure 2.** Prevalence of breast pain (%) by breast size and parity in random and active cohorts

*\*denotes significant difference between groups*

Postprint

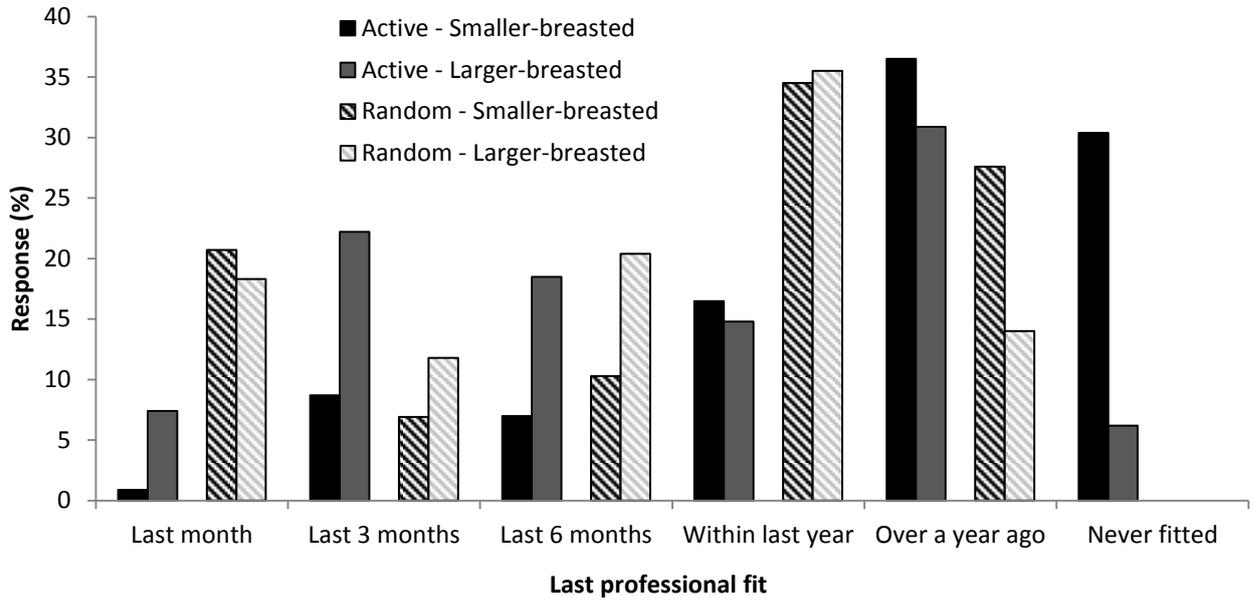
**Table 2.** Severity and frequency of breast pain experienced by symptomatic participants in the random (n = 100), active (n = 74) and total population (n = 174).

<b>Severity of breast pain (%)</b>	<b>Mild</b>	<b>Discomforting</b>	<b>Distressing</b>	<b>Horrible</b>	<b>P</b>
Random cohort	33.3	57.6	2.0	7.1	0.089
Active cohort	35.6	54.8	8.2	1.4	
Total population	34.3	56.4	4.7	4.7	
<b>Frequency of breast pain (%)</b>	<b>Daily</b>	<b>Weekly</b>	<b>Monthly</b>	<b>Every 2-3 months</b>	<b>P</b>
Random cohort	11.0	9.0	53.0	27.0	0.394
Active cohort	12.9	10.0	40.0	37.1	
Total population	11.8	9.4	47.6	31.2	

**Table 3.** Frequency of bra issues experienced during physical activity in the random cohort (n = 234), active cohort (n = 234) and total population (n = 468).

	Population	Frequency of bra issue (%)				P
		Never	Rarely	Sometimes	Often	
Shoulder straps dig in	Random	35.9	24.4	31.2	8.5	0.109
	Active	47.0	20.5	26.1	6.4	
	<b>Total</b>	<b>41.5</b>	<b>22.4</b>	<b>28.6</b>	<b>7.5</b>	
Rubbing / Chaffing	Random	53.8	22.2	20.9	3.0	< 0.001*
	Active	37.2	31.2	22.6	9.0	
	<b>Total</b>	<b>45.5</b>	<b>26.7</b>	<b>21.8</b>	<b>6.0</b>	
Upper body pain due to bra use	Random	43.7	23.8	28.6	3.9	< 0.001*
	Active	71.4	11.5	14.5	2.6	
	<b>Total</b>	<b>57.3</b>	<b>17.5</b>	<b>21.4</b>	<b>3.2</b>	
Poor posture due to bra use	Random	77.4	11.5	7.7	3.4	0.526
	Active	79.9	12.8	4.7	2.6	
	<b>Total</b>	<b>78.6</b>	<b>12.2</b>	<b>6.2</b>	<b>3.0</b>	
Underwire digs in	Random	78.2	14.5	5.6	1.7	0.001*
	Active	79.5	5.6	12.4	2.6	
	<b>All</b>	<b>78.8</b>	<b>10</b>	<b>9</b>	<b>2.1</b>	

\*denotes significant difference between cohorts



**Figure 3.** Percentage distribution of professional bra fitting in the random (n = 180\*) and active cohort (n = 196\*\*).

\*54 participants reported that they could not recall when they were last fitted

\*\*38 participants reported that they could not recall when they were last fitted

POSTPRINT