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Does breast size affect how women participate in physical activity?

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ABSTRACT

Objectives: Research has shown that women with large breasts experience increased breast motion, which can act as a barrier to participating in physical activity. Despite this evidence, limited research has investigated the effect of breast size on physical activity participation.
Design: Cross-sectional study.
Methods: 355 Australian women (aged 18–75 years) who volunteered as participants were divided into four breast size groups (small, medium, large and hypertrophic). All participants completed the Active Australia Survey to assess their participation in physical activity in the previous week, and were asked to indicate whether they agreed or disagreed that their breast size affected their participation in physical activity. Participant responses to time spent in each type of activity were compared across the four breast size groups using an ANCOVA design, controlling for age.
Results: Participants with hypertrophic breasts participated in significantly less total physical activity per week, particularly less vigorous-intensity physical activity, compared to their counterparts with smaller breasts. Participants with large breasts also participated in less vigorous-intensity physical activity compared to participants with small and with medium breasts, and a high percentage of women with large and with hypertrophic breasts perceived their breast size to affect the amount and intensity of physical activity they performed.
Conclusions: Breast size should be acknowledged as a potential barrier to women participating in physical activity. Strategies to assist women with large and hypertrophic breasts participate in all types and intensities of physical activity are needed so women can enjoy the health benefits associated with an active lifestyle.

1. Introduction

Regular participation in physical activity has been associated with numerous positive health benefits, including lessening the potential of incurring chronic disease and the associated risk of premature death.[1,2] Despite these positive health benefits, 58% of Australian women do not meet the recommended physical activity guidelines (150–300 min of moderate-intensity physical activity or 75–150 min of vigorous intensity physical activity per week; being active on most, preferably all, days every week; and doing muscle strengthening activities on at least 2 days each week) and the percentage of women not meeting these guidelines increases with advancing age.[3] Several factors contribute to the low adherence to physical activity participation by women including a lack of time, interest, discipline, skill, money, encouragement or motivation; being self-conscious; experiencing urinary incontinence; being too tired; poor weather; being ill or injured; family commitments or travel time.[2,4] One possible contributing factor that is often overlooked within the physical activity literature but has been acknowledged as a barrier to physical activity participation for women, is exercise-induced breast discomfort.[5–7]

Exercise-induced breast discomfort is breast discomfort or pain caused by excessive motion of the breasts when women participate in physical activity.[8,9] It has been reported that breasts can move up to 19 cm vertically[5,9,10] and up to 4 cm in the medial-lateral and anterior-posterior planes when women are active,[11] with the breasts moving more during vigorous activities such as running and jumping compared to less vigorous activities such as walking.[5,10] Importantly, as little as 2 cm of breast motion can cause exercise-induced breast discomfort.[9] Breast motion is also known to be greater among women with larger breasts, due to the increased force (mass × acceleration) applied to breasts with a greater mass.[6,7] Excessive breast motion can lead to pain and embarrassment during physical activity,[12,13] which may negatively

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affect the ability of some women to participate in physical activity. Therefore, it is important that we understand the potential association among breast size, breast motion and the ability of women to participate in physical activity.

Only two published studies have compared physical activity participation levels reported by women of different breast sizes (small vs large breasts).[7,13] Although no significant between-group differences in physical activity participation levels were found in either study, both studies had study design limitations (e.g. only young participants, self-reported breast size) that are likely to have influenced the findings. Due to these limitations, further research is required to better understand the effect of breast size, across the entire breast size spectrum, on physical activity participation levels among women. Information of this nature could be used to inform future evidence-based public health strategies related to encouraging greater levels of physical activity participation among women. Therefore, this study aimed to determine the effect of breast size, across the breast size spectrum (small, medium, large and hypertrophic),[14] on the duration and intensity of participation in physical activity reported by women living in the community. It was hypothesised that women with larger breasts would spend less time in vigorous-intensity activity and, therefore, less total time in physical activity, compared to women with smaller breasts.

2. Methods

Three hundred and seventy-eight Australian women aged 18 years and over volunteered to participate in a study, which investigated the breast characteristics of Australian women following advertisement of the study throughout the local community, University and Women's Health Centres. Participants were excluded from participation if they: (i) were pregnant or breast feeding (ii) had epilepsy that could be induced by the flashing light of the scanner or (ii) were unable to assume the prone scanning position due to the effects of these factors on breast volume or the breast volume measurement. Although there was no upper age limit to participate in the larger breast characteristics study, the physical activity survey instrument we used has been validated to measure participation in leisure time physical activity among persons aged 18–75 years.[15] Therefore, of the initial 378 volunteers, data for 355 women were included in the current study (age range: 18–75 years, mean: 42.3 ± 18.4 years; BMI range (calculated as mass (kg)/height^2 (m)): 19–55 kg/m^2, mean: 27.5 ± 6.2 kg/m^2). Approval for the study was obtained from the University of Wollongong Human Research Ethics Committee (HE 13/424). All participants provided written informed consent prior to testing and all testing was conducted according to the NHMRC Statement on Human Experimentation.[16]

In order to characterise each participant's breast size, the volume of their left and right breasts were directly quantified using procedures described in detail elsewhere.[17] In brief, each participant's breasts were scanned using a hand-held three-dimensional scanner (Artec™ Eva 3D Scanner, Artec Group, San Jose) while they lay in a prone position, with their breasts freely suspended in a gap between two tables. These scans were subsequently imported into software where a three-dimensional model of each breast was created (Geomagic Studio® software; Version 12; 3DSystems, South Carolina, USA) and the volume of each breast was calculated in millilitres (mL).[14,17] The participants were then divided into four groups based on the volume of their left breast.[14] The four breast size groups were: (i) small: breast volume <350 mL (n = 98, mean age: 35 ± 15 years; mean BMI: 23 ± 3 kg/m^2; mean breast volume: 228 ± 73 mL (left), 220 ± 81 mL (right), (ii) medium: breast volume 350–700 mL (n = 132, mean age: 41 ± 19 years; mean BMI: 26 ± 4 kg/m^2; mean breast volume: 500 ± 103 mL (left), 492 ± 125 mL (right), (iii) large: breast volume 701–1200 mL (n = 82, mean age: 48 ± 18 years; mean BMI: 31 ± 5 kg/m^2; mean breast volume: 921 ± 140 mL (left), 901 ± 194 mL (right), and (iv) hypertrophic: breast volume >1200 mL (n = 43, mean age: 53 ± 16 years; mean BMI: 35 ± 7 kg/m^2; mean breast volume: 1683 ± 458 mL (left), 1670 ± 522 mL (right).

Participants responded to eight questions from the Active Australia Survey[15] pertaining to their participation (frequency and duration) in four types of activity (walking, moderate-intensity activity, vigorous gardening and vigorous-intensity activity) in the week preceding survey completion. From participant responses to the self-report survey questions, the total time each participant reported to spend in each activity was calculated in minutes. Participant responses to the question assessing moderate intensity activity were combined with the walking question as a measure of *total* moderate-intensity activity.[15] To reduce errors associated with over-reporting, participants who reported times greater than 840 min for a single activity type were recoded to 840 min (n = 2).[15] The time spent in *total* moderate-intensity activity, vigorous gardening and vigorous-intensity activity were then summed to calculate the total time (minutes per week) that participants spent in physical activity.[15] On the written survey participants were also asked to indicate their level of agreement (rated from 1 (strongly disagree) to 5 (strongly agree)) with the statement:

> *"My breast size has affected the amount and level of physical activity I partake in currently or in the past (or both)."*

If participants agreed with this statement they were asked to indicate what activities they perceived were affected. Each survey was completed by hand or online through the Qualtrics survey platform (Qualtrics, United States).

Descriptive statistics for the time participants reported spending in each activity, as well as the total time that participants reported spending in physical activity were calculated for each breast size category, grouped with respect to six age categories (18–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years and 65–74 years). The six age categories enabled later comparison of data from the current study to normative population data.[18] To avoid effects of over-reporting, data were visually inspected and participants who reported more than three standard deviations greater than the age group mean for any activity were excluded from analysis (n = 31). The percentage of participants who either agreed or strongly agreed with the breast size and physical activity statement was calculated.

Data for vigorous-intensity activity were log transformed (Lg10) to meet the normality and homogeneity of variance assumptions underlying parametric statistics. A one-way ANCOVA design was then used to determine whether there was any significant ($p < 0.05$) main effect of breast size on the outcome variables, controlling for age (covariate). Where significant main effects were identified, Bonferroni post hoc tests were used to determine where differences lay. All calculations were performed using the Statistical Package for the Social Sciences (Version 21.0; SPSS Inc., Chicago, IL).

3. Results

The age distribution of the entire participant cohort, compared to normative population data is shown in Table 1(a). The time that participants reported to spend in each activity compared to population data from the Australia Health Survey is shown in Table 1(b), which implemented aspects of the Active Australia Survey.

The mean time participants reported spending in each activity, as well as the total time participants reported spending in physical activity, are shown for the four breast size groups in Fig. 1. When controlling for age, breast size was found to have a significant effect

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Table 1
The age distribution of a sample of the Australian female population (n = 8093) and the current study cohort (n = 355) are shown in (a). Normative physical activity data for both datasets are reported for each activity type (total time in physical activity, total moderate-intensity activity, vigorous-intensity activity and vigorous-gardening), with respect to age in (b).

(a)

	Australian female population[a] (%)	Study cohort (%)
Number of participants	8093	355
Percent of sample aged 18–24 years	7.9	26.2
Percent of sample aged 25–34 years	17.5	19.4
Percent of sample aged 35–44 years	19.2	10.2
Percent of sample aged 45–54 years	18.5	12.9
Percent of sample aged 55–64 years	16.5	13.1
Percent of sample aged 65–74 years	11.3	18.1

(b)

	Australian female population[a] (weighted mean)	Study cohort (mean ± SD)
Total time physical activity (min)[b]		
18–24 years	233	490 ± 329
25–34 years	249	523 ± 355
35–44 years	253	388 ± 307
45–54 years	286	393 ± 331
55–64 years	249	399 ± 318
65–74 years	227	449 ± 307
Total moderate-intensity activity (min)[c]		
18–24 years	158	294 ± 246
25–34 years	172	318 ± 141
35–44 years	164	225 ± 191
45–54 years	181	224 ± 220
55–64 years	175	257 ± 219
65–74 years	161	276 ± 222
Vigorous-intensity activity (min)[d]		
18–24 years	62	182 ± 169
25–34 years	50	170 ± 141
35–44 years	48	95 ± 104
45–54 years	52	116 ± 136
55–64 years	19	63 ± 120
65–74 years	18[e]	55 ± 91
Vigorous gardening (min)[f]		
18–24 years	13	13 ± 36
25–34 years	27	27 ± 61
35–44 years	41	21 ± 48
45–54 years	53	47 ± 78
55–64 years	53	67 ± 99
65–74 years	48	99 ± 111

[a] Based on data collected from the Australian Health Survey, Nutrition and Physical Activity, 2011–12 (ABS, 2014).
[b] Total time spent in physical activity is a summation of the time spent in total moderate-intensity activity, vigorous gardening and vigorous-intensity activity across the week preceding survey completion.
[c] Total moderate-intensity activity is a combination of time spent in walking and moderate-intensity activity.
[d] Because the transformed vigorous intensity activity data showed similar trends to the untransformed data, the untransformed breast volume data has been presented in this section for ease of interpretation.
[e] This estimate is acknowledged by the ABS to have a relative standard error of 25–50% and, as such, is advised to be used with caution.
[f] Refers to vigorous-intensity gardening and yard work.

on the total time spent in physical activity. That is, participants with small breasts reported spending significantly more total time participating in physical activity than participants with hypertrophic breasts (Fig. 1(d)). Breast size was also found to have a significant effect on the time participants reported spending in vigorous-intensity activity, whereby participants with small breasts spent significantly more time in vigorous-intensity activity compared to participants with large breasts and participants with hypertrophic breasts (Fig. 1(c)). There was no significant difference between groups for the reported time spent in total moderate-intensity activity or vigorous gardening (Fig. 1(a and b)). The percentage of participants who agreed or strongly agreed with the breast size and physical activity statement, increased with increasing breast size group (Table 2(a)). The types of activities that the participants most commonly reported to have been affected by their breast size are also shown in Table 2(a), together with the BMI distribution of the four participant groups (Table 2(b)).

4. Discussion

This is the first study to present physical activity participation data reported by a large sample of women living in the community, who represented the entire breast size spectrum. Breast size was found to have a significant effect on the total time participants reportedly spent participating in physical activity, as well as the time participants reported to spend performing vigorous physical activity. The implications of these findings are discussed below.

The time that participants in the current study reported to spend performing physical activity was substantially greater than population norms (Table 1(b)), suggesting that participants in the current study were either more active than women in the general population or that they over-reported the time they spent performing physical activity in the previous week. Despite this, mean data for time spent performing total moderate-intensity activity

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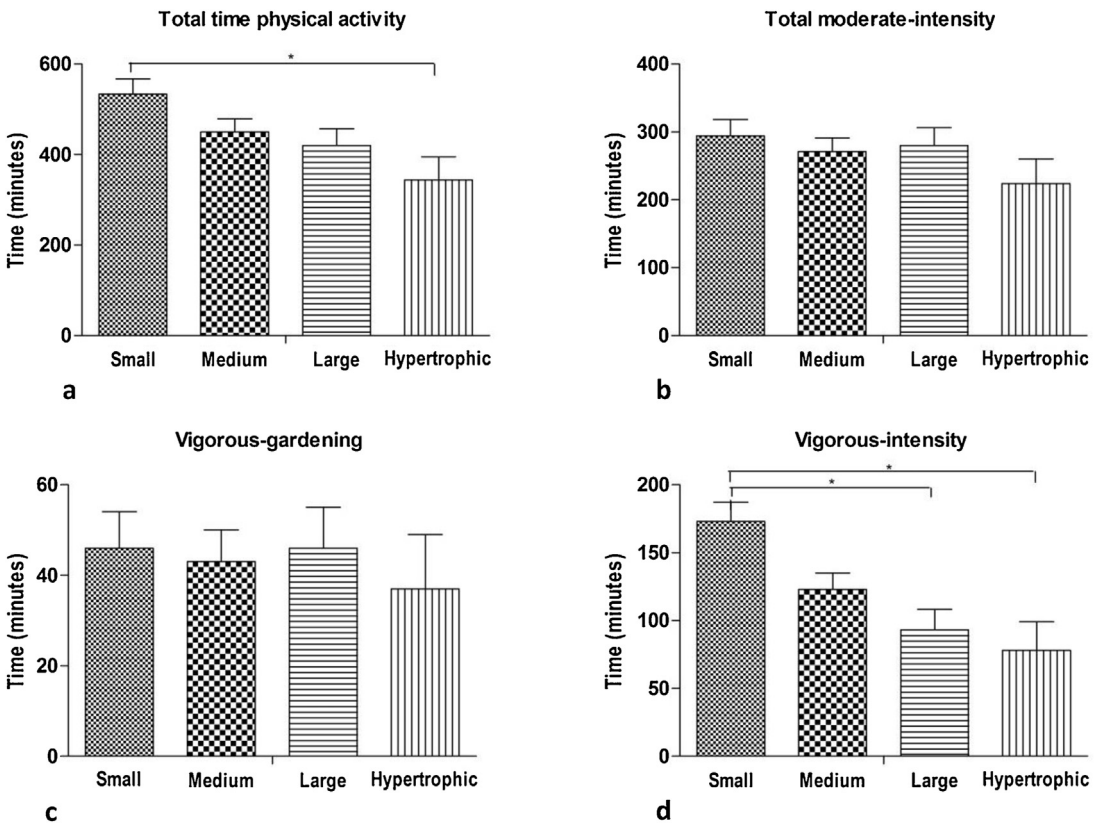

Fig. 1. The mean ± standard error time participants reported to spend performing physical activity per week are shown for the four breast size groups, controlling for the effects of age. (a) total time physical activity, (b) moderate-intensity activity, (c) vigorous gardening and, (d) vigorous-intensity activity. *Indicates a significant difference between groups. NB: as the transformed vigorous intensity activity data showed similar trends to the untransformed data, the untransformed breast volume data has been presented in this section for ease of interpretation.

Table 2
The number and percentage of participants who agreed (combined 'strongly agree' and 'agree') with the breast size and physical activity statement[a], as well as the types of activities identified as being affected by breast size are shown in (a). The number and percentage of participants within each BMI group (normal, overweight and obese) are shown for the four breast size groups in (b).

(a)

	Small (n = 98)	Medium (n = 132)	Large (n = 82)	Hypertrophic (n = 43)
Breast size affects my physical activity[a] (n; %)	7 (7)	31 (23)	38 (46)	25 (58)
Current	0 (0)	11 (8)	16 (20)	10 (23)
Past	6 (6)	11 (8)	7 (9)	4 (9)
Both	1 (1)	9 (7)	15 (18)	11 (26)
Activity type (n; %)[b]				
Running/jogging	6 (6)	22 (17)	32 (39)	15 (35)
Aerobics/dance/jumping/gym	0 (0)	10 (8)	11 (13)	14 (33)
Team sports/basketball/netball	0 (0)	7 (5)	5 (6)	6 (14)
Swimming	0 (0)	2 (2)	7 (9)	4 (9)
Walking	0 (0)	1 (1)	3 (4)	5 (12)
Not specified	1 (1)	6 (5)	2 (2)	3 (7)

(b)

BMI group (range)	Small (n; %)	Medium (n; %)	Large (n; %)	Hypertrophic (n; %)
Normal (18.5–24.9 kg/m^2)	85 (86.7)	64 (48.5)	7 (8.5)	2 (4.7)
Overweight (25–29.9 kg/m^2)	10 (10.2)	46 (34.8)	31 (37.8)	8 (18.6)
Obese (≥30 kg/m^2)	3 (3.1)	22 (16.7)	44 (53.7)	33 (76.7)

[a] Percentage of participants agreeing with the statement "My breast size has affected the amount and level of physical activity I partake in currently or in the past".
[b] Some participants listed more than one activity type to be affected by their breast size; as such the totals for some activity types exceed the total number of participants.

and vigorous-intensity activity recorded in the current study were consistent with those reported in similar research on a sample of women living in the UK (vigorous intensity: 161 ± 297 min[7] vs 124 ± 144 min (current study); moderate-intensity 241 ± 392 min[7] vs 274 ± 231 min (current study)). In addition, despite differences in the absolute values between the Australian population data and data for the current participant cohort, both data sets showed that reported participation in all types of physical activity tended to decline with age (except gardening) and this was most evident for participation in vigorous-intensity activity (Table 1(b)).

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In support of our hypothesis, the total time that participants reported to spend performing physical activity declined with increasing breast size (Fig. 1(d)). However, this decline was significant only between participants with small and hypertrophic breasts, whereby, when age was controlled for, participants with hypertrophic breasts reported spending approximately 37% less total time performing physical activity per week than their counterparts with small breasts. Although this finding suggests that breast size negatively impacts total physical activity participation among women with hypertrophic breasts, this finding should be interpreted in light of the multifactorial issues associated with breasts of this size. For example, 76% of participants with hypertrophic breasts were classified as having an obese body mass index, and people who are obese have been shown to participate in less physical activity compared to non-obese individuals.[19] As a large body size can be associated with a large breast size,[14] it is unknown whether the decreased physical activity participation is most affected by breast size, body size or a combination of the two among these women. Furthermore, women with hypertrophic breasts have been found to suffer from an increased prevalence of psychosocial issues surrounding negative body image,[20] report difficulty finding a suitable sports bra to wear when active[21] and experience an increased prevalence and severity of musculoskeletal pain.[21–23] Therefore, it is likely that a combination of these variables adversely affect the ability of women with hypertrophic breasts to participate in physical activity, contributing to the overall reduced total time spent performing physical activity among the current study cohort. Despite these factors, it is important to highlight that 24% of participants with hypertrophic breasts were not obese (19% overweight and 5% normal BMI; Table 2(b)), and not all women with hypertrophic breasts will suffer negative health consequences that subsequently impact upon their participation in physical activity. As such, breast size must be acknowledged as a potential independent barrier to participation in physical activity within the literature.

When total time spent performing physical activity was broken down by activity, in agreement with our hypothesis, breast size was found to significantly affect the intensity of physical activity that participants self-reported. That is, participants with large and with hypertrophic breasts reported they participated in significantly less vigorous-intensity physical activity compared to participants with small breasts (Fig. 1(c)). Interestingly, there was no significant main effect of breast size on participation in either total moderate-intensity activity or vigorous-gardening (Fig. 1(a and b)), which is likely to be a reflection of the small amount of breast motion induced by these activities. Previous research has, however, associated an increased amount of breast motion and exercise-induced breast discomfort with larger breast sizes and vigorous activities.[5–7] It is therefore reasonable to assume that the reduced participation reported performing vigorous-intensity physical activity by women with large breasts and with hypertrophic breasts is likely to be linked to the exercise-induced breast discomfort the women experience during vigorous-intensity physical activity. Support for this notion is evidenced by the large percentage (46–58%) of participants with large breasts and with hypertrophic breasts that agreed that their breast size has currently or in the past, affected the amount and level of physical activity they participated in. Although participating in any intensity of physical activity is better than not participating in any activity at all,[24] vigorous-intensity activity is thought to confer greater health benefits compared to low and moderate-intensity activity[25,26] and the health benefits can be achieved in a substantially shorter period of time (e.g. such as when performing high intensity interval training).[27] The benefits of vigorous-intensity physical activity are important, particularly for women who report a lack of time as a common barrier to physical activity participation.[2,4] Therefore, strategies to promote participation in all types and intensities of physical activity, including vigorous-intensity physical activity, across the breast size spectrum are needed. Strategies for young women are particularly important to ensure good physical activity practices are developed early and sustained across their lifetime. Strategies should include education surrounding the importance of correct breast support, including the importance of different features of a well-designed sports bra, as well as training on how to correctly fit a sports bra. Research has consistently shown that wearing a well-fitting and supportive sports bra can substantially reduce breast displacement and exercise-induced breast discomfort[5] and, as such, is recommended for women when participating in physical activity.[5,28]

Running and jogging based activities rated among the highest of the activities that participants reported to be affected by their breast size (21% of total cohort; Table 2(a)). These activities were most problematic for women with larger breast sizes (46–58%), which is consistent with data reported in previous literature.[5,10] Similarly, activities that involve jumping and bounding motions, such as dancing, aerobics and dynamic team sports, were also identified as problematic for women with larger breasts. These findings further highlight the need for women with larger breasts to have access to well-designed sports bras that can provide sufficient support when these women participate in dynamic, vigorous-intensity activities. Unfortunately, research has repeatedly shown that many women are dissatisfied with current sports bras and experience fit issues.[21,29] A similar problem was identified for swimwear whereby 9% of participants in the current study who had large breasts or hypertrophic breasts reported swimming as an activity that they felt breast size affected their ability to participate in, and may reflect the difficulty they encounter finding suitable swimwear, as was reported by many participants. Therefore, improvements to both sports bra fit and bra design, as well as swimwear fit and design are needed so that women of all breast sizes can comfortably participate in all types and intensities of physical activity.[30] Improvements in swimwear are particularly relevant because aquatic-based activities have been shown to be a more comfortable mode of activity for women with larger breast sizes compared to land-based activities.[8]

The results of the current study must be interpreted in light of the limitations of this research. Firstly, as the physical activity data were based on self-report data, it is likely that participants over reported their time spent participating in physical activity. In order to reduce errors associated with self-reporting, it is recommended that a quantitative measure of physical activity be used in future research in this field. Secondly, the study population included a large percentage of younger women (26% aged 18–24 years; Table 1(a)), which may have contributed to the greater time reported to be spent performing physical activity compared to population data (Table 1(b)).

5. Conclusion

This study provides evidence of the adverse effects of a large and a hypertrophic breast size on duration and intensity of participation in physical activity. Consequently, breast size must be acknowledged as a potential barrier to women participating in physical activity within the literature. Furthermore, evidence-based strategies to promote participation in all types and intensities of activity, including vigorous-intensity physical activity, among women with large and with hypertrophic breast sizes are needed so women can enjoy the health benefits associated with an active lifestyle. Strategies should include education surrounding the importance of correct breast support, including the importance of the different features of well-designed sports bras and how to correctly fit a sports bra.

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Practical implications

- Breast size should be acknowledged as a potential barrier to women participating in physical activity.
- Strategies to promote participation in all types and intensities of physical activity, including vigorous-intensity physical activity, across the breast size spectrum are needed. This is most important for women with large and with hypertrophic breast sizes.
- Clinical practice should aim to provide education surrounding the importance of correct breast support, including the importance of the different features of well-designed sports bras and how to correctly fit a sports bra.

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Data sharing

Due to human research ethics obligations, the authors cannot share additional data.

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