

The impact of online educational talks on young equestrians' knowledge of breast health and breast issues

Cameron, Lorna; Smith, R.; Stones, N. C.; Freeman, M; Lewis, Victoria; Dumbell, Lucy; Burbage, J.

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1 **The impact of online educational talks on young equestrians' knowledge of breast**
2 **health and breast issues**

3

4 L.J. Cameron^{1*}, R. Smith², N.C. Stones², M. Freeman², V. Lewis¹, L. Dumbell¹ and J.
5 Burbage³

6 ¹ Hartpury University, GLOUCESTER, GL19 3BE

7 ² University Centre Sparsholt, WINCHESTER, SO21 2NF

8 ³ University of Portsmouth, PORTSMOUTH, PO1 2UP

9 *Author to whom any correspondence should be addressed; e-mail:

10 lorna.cameron@hartpury.ac.uk Tel:+44 1452 702173

11 **Abstract**

12 The breasts are a barrier to female participation in physical activity. Breast and bra issues are
13 prevalent in female horse riders. Wearing a sports bra can minimise these issues, but many do
14 not exclusively wear one for horse-riding. This study investigated the impact of live online
15 breast educational talks on subsequent self-perception of knowledge and understanding. Two
16 online surveys (GoogleForms™), one immediately pre-talk and one immediately post-talk,
17 were created to assess perceived impact. Talks consisted of five sections: breast anatomy; types
18 of sports bras; breast issues in relation to exercise; breast issues specifically related to horse
19 riders and importance of increasing awareness in the horse-riding community. Four educational
20 talks were delivered to different groups of college and university students (n=67) studying
21 equine courses. Completed pre- and post-talk surveys (40 female, 2 male) were analysed using
22 a generalised linear model and post hoc Tukey tests. Comfort talking to others about breast
23 health issues increased significantly after the talks, particularly for larger breasted (\geq D cup)
24 participants ($p=0.032$). Knowledge of bra fit, breast support and breast pain significantly
25 increased ($p<0.01$) post-talk, particularly in those who had not previously experienced breast
26 pain whilst horse riding ($p\geq 0.001$). The intervention was successful at increasing participant
27 understanding and knowledge of breast health issues, although different educational tools such
28 as access to online resources or in-person talks may prove beneficial to equestrians to further
29 increase comfort in broaching breast health issues with peers and support networks in future.

30 Key words: horse rider, breast, issues, stigma, education

31 **1. Introduction**

32 Participation in regular exercise improves both physical and mental wellbeing [1]. Regular
33 physical activity drastically reduces the development of serious diseases, i.e. Type 2 diabetes,
34 heart disease and osteoarthritis and reduces the risk of stress and depression [2]. Recently
35 emphasis has been placed on increasing levels of physical activity, with the World Health
36 Organisation (WHO) recommending adults participate in at least 150 minutes of moderate
37 intense exercise per week [3]. Despite this, only 50-60% of adults meet aerobic exercise
38 guidelines, lessening to 30% who meet aerobic and resistance training guidelines [4].
39 **Increasing rates of obesity, a factor known to contribute to health problems, highlight the**
40 **crucial need for more people to engage in regular exercise.** However, Audickas [5] found 63%
41 of men in the United Kingdom (UK) participate in exercise and only 58% of women. A popular

42 sport for females is equestrian activities, with 74% of horse riders in the UK being female [6].
43 For many, it is also the only form of physical activity undertaken [7]. To increase female
44 physical activity and participation in equestrianism, it is important to understand barriers to
45 participation.

46 1.1 The breast as a barrier to participation

47 The breast has been identified as a significant barrier to female participation in equestrian
48 activity [8] and Burnett *et al.* [9] found that the breast was the fourth greatest barrier to
49 participation in sport. Breast pain is a common barrier and often increases with exercise
50 intensity [10, 11]. Excessive breast motion during exercise is more prevalent in larger-breasted
51 women (\geq D cup) which may prove problematic in equestrianism as Burbage and Cameron
52 [12] found that over 50% of equestrian survey respondents were in this category. This
53 increased breast movement not only causes pain, but also embarrassment [13], and may impact
54 female equestrian participation.

55 The female breast is a malleable structure, readily deformed by external forces [14]. The breasts
56 contain between 15-20 lobes, adipose tissue filling spaces between, interspersed with nerves
57 and blood vessels [15]. The breast lies over the pectoralis major muscle but the breasts
58 themselves contain no muscle; their main supporting structures being Cooper's Ligaments and
59 covering skin, which if damaged are irreparable [16]. As little as 2cm of relative breast
60 movement can cause pain, however, breasts can move up to 19cm vertically and 4cm in the
61 medial-lateral and anterior-posterior planes during physical activity [13]. Research has shown
62 that wearing suitable breast support can minimise the risk of excessive breast movement and
63 alleviate associated breast pain (mastalgia) [11,17-19].

64 Activity levels in females have been shown to decline during adolescent years [9] with breast
65 concerns contributing to unwillingness to exercise. Scurr *et al.* [20] found nearly half of over
66 two thousand schoolgirls reported that their breasts contributed to unwillingness to complete
67 compulsory exercise, and yet, did not wear a sports bra. Horse-riding is popular in adolescent
68 females, but their participation may decline if they experience breast issues when riding,
69 suggesting that breast health and breast support education may have an important role to play
70 in maintaining female equestrian participation.

71 1.2 Breast issues in female horse riders

72 Horse-riding is a moderate intensity exercise inducing similar breast movements to running
73 and jumping activities [12]. Burbage and Cameron [8] reported 40% of equestrian survey
74 respondents experienced breast pain with 21% reporting negative riding performance effects.
75 Burbage and Cameron [12] found at least one breast-associated barrier reported by 25% of
76 respondents. Despite breast pain, many women do not wear a sports bra for horse-riding [8].
77 Studies have shown that wearing appropriate breast support for horse-riding reduces breast
78 movement and exercise-induced breast pain (EIBP) [18,19] and has rider performance
79 implications. Given the positive effects of wearing a sports bra, it is surprising that uptake is
80 low when horse-riding. However, not wearing a sports bra is not limited to female equestrians
81 [21] and greater education on breast health and bra usage across a wide demographic of
82 exercising females is warranted.

83 1.3 A need for breast health education

84 Many females suffer from breast-related issues including: incorrect bra fit, excessive breast
85 movement and pain, breast sag (ptosis) and embarrassment, all of which can negatively affect
86 health and well-being. However, knowledge and awareness of these issues is low, especially
87 in adolescent females compared to adult females [22]. McGhee *et al.* [23] identified a need to
88 educate adolescent female athletes about bra knowledge and fit. McGhee and Steele [24] argue
89 that a well-fitted sports bra is essential equipment for those wishing to participate in sport at
90 any level. However, there is a lack of evidence-based guidelines providing information on
91 breast health and bra fit and sporting females may be unwilling to discuss such issues with
92 male coaching staff. Creating resources that male coaches can signpost their clients to, to find
93 useful and correct information, may lessen these difficulties.

94 These resources are not available within the school curriculum [25] and Omrani *et al.* [22]
95 found that educating adolescent girls improves their breast knowledge making them feel more
96 informed and less embarrassed. For equestrian adolescents, horse-riding may be their only
97 physical activity and as activity levels decline during the post adolescence years, improving
98 breast and bra knowledge through specific equestrian focussed educational interventions may
99 help young females to feel better equipped, more comfortable when horse-riding and more
100 likely to continue this activity into adult life.

101 The aim of this study was to assess the impact of equestrian focussed educational talks on the
102 topic of female horse rider breast health and related issues on listener knowledge and awareness
103 of the subject. It was hypothesised that talks would significantly increase listener knowledge
104 about breast health and would increase listener comfort to discuss breast health issues with
105 others.

106 **2. Method**

107 **2.1 Study Design**

108 Following institutional ethical approval from the Sparsholt Research and Ethics Group, a breast
109 education intervention titled '*Breast Health in the Female Equestrian*' was offered to a range
110 of equine students in the form of an online short lecture. Four groups of students, and their
111 lecturers, studying equine courses at further education level and undergraduate level were
112 recruited **between March and April 2021**. All participants were over 18 years of age **and**
113 **confirmed they were current equestrians**. To assess the impact of this educational talk, two
114 surveys were created using Google Forms™, completed immediately pre- and post-talk. These
115 surveys were designed to take no more than 10 minutes to complete and included yes/no,
116 multiple-choice, 5-point Likert scales, 10-point Numeric Rating Scales (NRS) and short answer
117 questions.

118 **2.1.1 Pre-talk survey**

119 **The pre-talk survey had two versions, one for participants identifying as female and one for**
120 **other participants (identifying as male or non-binary or whom chose not to declare a self-**
121 **identification).** Part one of the pre-talk survey for those participants identifying as female
122 collected demographic information on age, self-reported bra-band size, bra cup size and the
123 types of bras worn for horse-riding Participants were asked to provide a word to allow pre- and
124 post-talk surveys to be matched. Part two identified bra fitting issues (chafing,
125 straps/underwire digging in, muscle ache, poor posture) and whether participants felt that their
126 bra choices met their needs for horse-riding using a multiple-choice grid and Likert scale. Part

127 three explored breast pain in relation to horse-riding and if they had spoken to anyone about it
128 using yes/no, multiple-choice, Likert scales and free text questions. The final part asked how
129 comfortable participants felt talking about the topic of breast health issues to others and to rate
130 their knowledge of bra-fit, breast support and breast pain using a 10-point NRS (1- not
131 comfortable, 10 - very comfortable). Pre-talk surveys for those participants identifying as male,
132 non-binary or prefer not to say had similar questions excluding questions relating to bra size,
133 bra comfort and experience of breast pain. Part one asked for age and **their** association with
134 horse-riding. Part two identified breast related issues they were aware of, and their comfort in
135 talking to horse-riding associates about breast issues using a multiple-choice and a 10-point
136 NRS question. The final part asked all participants if they would like access to resources about
137 breast health issues in horse riders. Pre-talk surveys were completed immediately before the
138 educational talks.

139 2.1.2 Post-talk survey

140 Part one of the female post-talk survey asked if participants would now talk to someone about
141 their breast pain if applicable and if yes, who they would talk to, using a multiple-choice
142 question. Part two explored the area of how comfortable they now were talking to others about
143 breast issues and if they would find online resources useful. Part three asked them to again rate
144 their knowledge of bra-fit, breast support and breast pain and whether the information given in
145 the talk had impacted their choice of bra for horse-riding using multiple-choice questions. The
146 final part asked for participant views on how useful the talk had been using a 10-point NRS (1-
147 not useful, 10 - very useful) and for any comments on areas they thought needed more research
148 or should have been discussed in the talk using free text questions. **Questions were formatted
149 to be short and clear, leading questions were avoided, Likert scales were utilised and the overall
150 time for completion of the questionnaire was kept short to limit potential bias.** For participants
151 identifying as male, non-binary or prefer not to say post-talk surveys used Likert scales and
152 yes/no questions to ask how comfortable they now felt about discussing breast issues with
153 others, whether they would find online resources useful and how useful the educational talk
154 had been as for female participants. The post-talk surveys were completed immediately
155 following the educational talks **to limit any bias due to recall memory.**

156 2.1.3 Educational intervention

157 The educational intervention was presented to four groups of students, and their lecturers,
158 studying equine courses at further education level (over 18 years of age) and undergraduate
159 level **where the course leader had agreed to time within timetabled sessions being used for the
160 study and the students had not already experienced a breast health education talk within their
161 syllabus.** The lecture was delivered via Microsoft Teams™ and in total, including time for
162 completing the surveys, took 40 minutes to adhere to existing timetabled sessions within the
163 institution. **Prior to data collection, the educational talk had been piloted with staff members
164 to ensure it was evidence based.** The talk included five sections: section one explained the
165 anatomy of the female breast; section two described the common types of sports bras that are
166 available on the market (encapsulation, compression, combination); section three detailed
167 breast issues in relation to exercise (bra fit, breast pain, performance, embarrassment); section
168 four explained breast issues specifically related to horse riders; section five explained the
169 importance of increasing awareness and knowledge of these issues in the horse-riding

170 community and how individuals can know if their bra is a good fit. The talk finished with the
 171 opportunity for any questions to be asked.

172 In total, 67 pre-talk survey responses (64 females, 3 males), and 49 post-talk survey responses
 173 (47 females, 2 males) were downloaded from Google Forms™ into a Microsoft Excel™
 174 spreadsheet. For comparison there were 40 complete pre- and post-talk female survey
 175 responses, and 2 males, that could be matched up for analysis using the word supplied by
 176 participants.

177 **2.1 Statistical analysis**

178 Microsoft Excel™ and Minitab 2021™ were used for data analysis. Descriptive analysis was
 179 used to summarise the demographic information of female participant bra band, cup size, and
 180 type of bra worn for horse-riding. Cup sizes A to C were classed as smaller-breasted females
 181 and cup size D and above were classed as larger-breasted [8]. Score data for comfort of talking
 182 to others; knowledge of bra fit, breast support and breast pain, and overall knowledge when the
 183 three categories were combined, were analysed using a generalised linear model **as the**
 184 **residuals were normally distributed**. Cup size and survey type (pre/post) and experiencing pain
 185 when riding were fixed factors and cup size nested in survey type, respondent was included as
 186 a random factor. Post hoc Tukey tests were run to compare the results with an alpha set at 0.05.

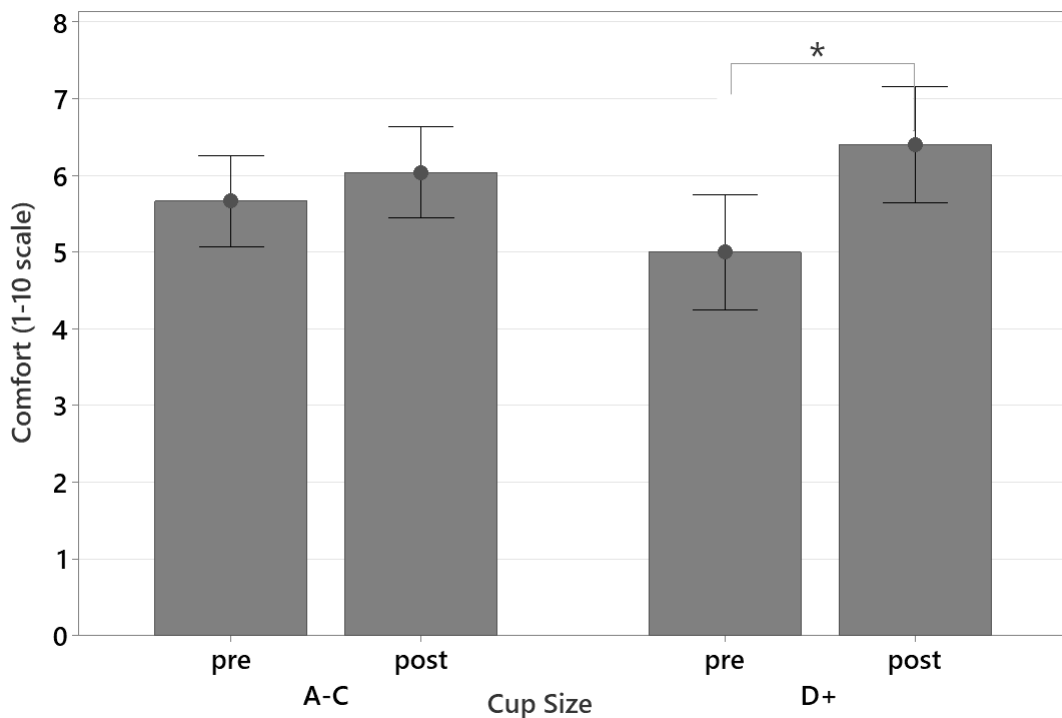
187 **3. Results**

188 The mode age of participants was 18 years (70%). Female participant bra (UK sizing) cup size
 189 ranged from an A cup to a G cup and under band size ranged from 26 to 48 inches (Table 1).
 190 The modal bra size was 34B. Of the 63 female participants, 63% were classed as smaller
 191 breasted (n=40) and 37% were classed as larger breasted (n=23). Only 34% of female
 192 participants wore a sports bra **during equestrian activities** and 63% wore an everyday bra of
 193 varying styles (Table 1). **Of riders (n=23) who reported a bra size in the larger breasted group**
 194 **(cup size > D), 30% exclusively wore a sports bra when riding**. Experiencing pain when horse-
 195 riding was reported by 17% of female participants (n=11). Of these, 55% were larger breasted
 196 and 45% were smaller breasted, **and only 18% (n=2) exclusively selected a sports bra when**
 197 **completing horse riding activities**.

198 *Table 1 Distribution of female participants' self-reported UK bra size.*

Underband inches)	Cup Size							Total
	A	B	C	D	DD	E	G	
26		1						1
28	2	1	1			2		6
30	1	1		1				3
32	2	8	6	2	1	1		20
34	1	7	6	1	4	2	2	23
36	1	1	2	3	2			9
38						1		1
40				1				1
Total	7	19	15	8	9	4	2	64

200 All respondents were more comfortable talking to others about breast health after the talk
 201 ($F_2=4.62, p=0.016$) and this was significantly more for respondents reporting larger breast sizes
 202 ($T=2.88, p=0.032$) (Figure 1).



203
 204
 205
 206
 207

Figure 1 Pre- and post-talk comfort scores when talking to others about breast issues (1- not comfortable, 10 - very comfortable) * indicates a significant difference

Table 2. Mean knowledge of breast issues pre and post talk (1 = very poor, 2 = below average, 3 = average, 4 = above average, 5 = excellent)

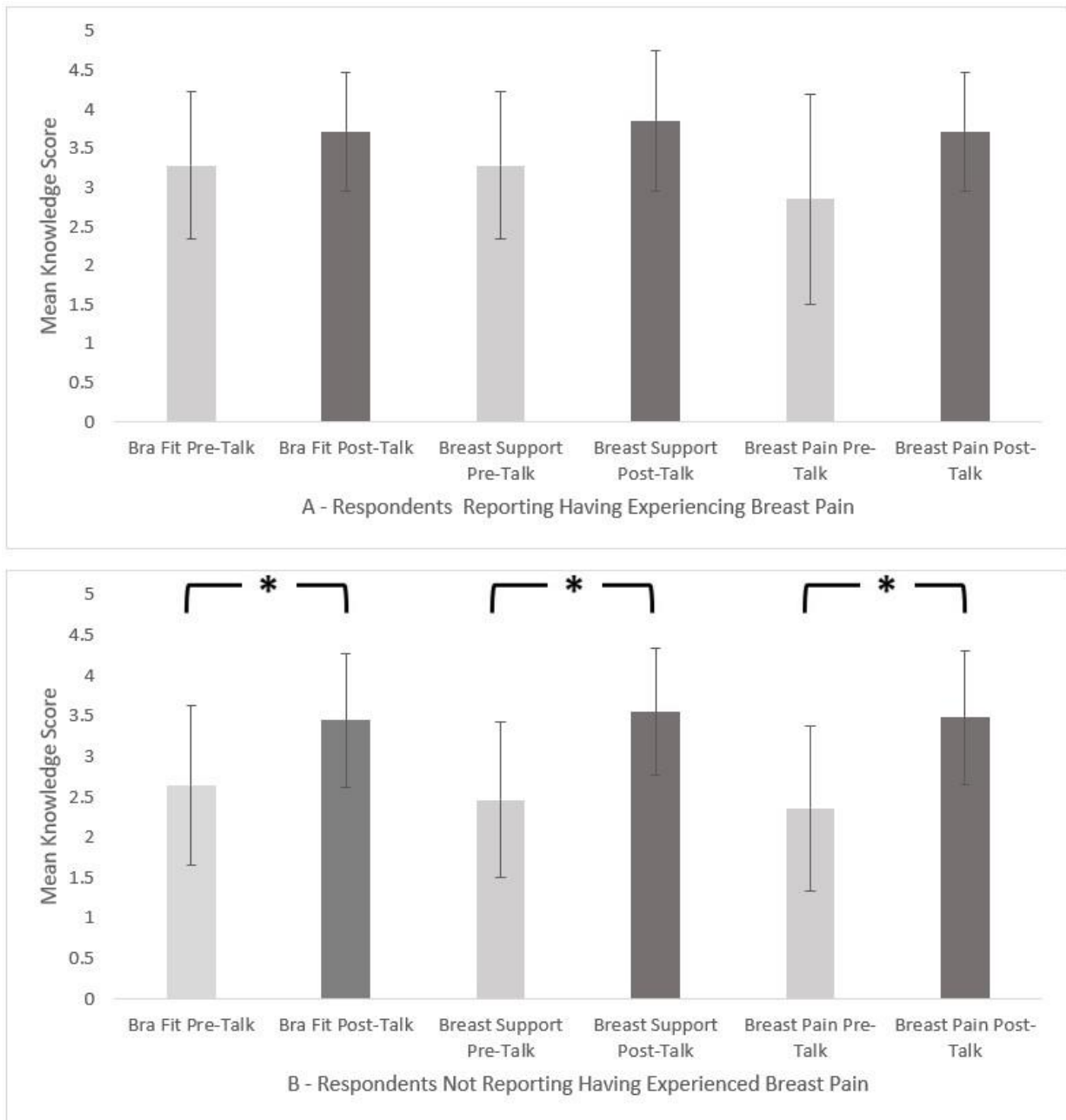
Breast issue	Pre-talk mean (\pm SD)	Post-talk mean (\pm SD)
Bra fit	2.7 (0.98)	3.5 (0.79)
Breast support	2.6 (0.97)	3.5 (0.82)
Breast pain	2.3 (1.08)	3.5 (0.79)
Overall knowledge	2.5 (1.01)	3.5 (0.79)

208 Post-talk knowledge of breast health issues; bra fit, breast support and breast pain all
 209 significantly increased compared to pre-talk knowledge levels ($F_2=20.04, p<0.01$; $F_2=25.94,$
 210 $p<0.01$; $F_2=35.22, p<0.01$, respectively) (Table 2).

211

212 There was no significant difference in knowledge of breast health issues between breast size
213 groups.

214 When asked whether breast pain was experienced when horse-riding there was no significant
215 difference in pre- and post-talk levels of comfort of talking to others ($F_2=0.61$, $p=0.548$),
216 though a significant difference was found for knowledge of breast issues ($F_2=8.55$; 15. 46;
217 14.04, $p<0.001$). When further compared by whether pain was experienced when horse-riding,
218 those that said NO had a significant increase in knowledge of breast pain ($T=5.07$, $p<0.001$),
219 breast support ($T=5.41$, $p<0.001$) and bra fit ($T= 4.03$, $p=0.001$) post talk (figure 2).



220

221 *Figure 2 Mean scores of pre- and post-talk knowledge (1 = very poor, 2 = below average, 3 = average, 4 = above*
222 *average, 5 = excellent) of breast issues for participants that said YES to experiencing breast pain (a) and NO to*
223 *experiencing breast pain (b) * indicates $p \leq 0.001$*

224 The two male participants that completed both the pre- and post-talk surveys felt that access to
225 online resources about breast issues in female horse riders would be useful. Of the 40 females
226 that completed both surveys, 83% (n=33) felt access to online resources would be useful and
227 17% (n=7) felt they would not be useful. The most frequent post-talk response to whether
228 female participants felt they would be able to give advice to others on breast issues was ‘yes,
229 but they would like further information’ (45%), followed by ‘no, but I could advise them where
230 to find information’ (35%). Nearly half of female participants (48%) were encouraged to
231 rethink their choice of bra for horse-riding, 23% reported they would change their bra type,
232 while another 23% reported they were happy with their current choice. **Of those who would
233 change their bra type choice, all already chose a sports bra for riding, but not exclusively and
234 none had reported experiencing breast pain in the pre-talk survey.** The usefulness of the talk
235 was given a score of 6 and above on the Numeric Rating Scale (1 – not useful 10 – very useful)
236 by 78% of all participants.

237

238 **4. Discussion**

239 The key aim of this study was to assess the impact that giving online educational talks on the
240 topic of breast health issues in female horse riders had on participants’ comfort in talking to
241 others about these issues and their knowledge of breast health issues.

242 Participants felt significantly more comfortable talking to others about breast issues post-talk,
243 particularly those with larger cup sizes. The problems relating to the breast (such as feelings
244 of embarrassment, not being able to find a correctly fitting bra and breast pain) are very
245 personal subjects to discuss and having an opportunity to discuss these issues may have helped
246 increase this comfort. There continues to be stigmas surrounding women’s health matters [26].
247 Vrinten *et al.* [27] found that cancer stigma exists, particularly surrounding breast cancer,
248 which can negatively influence behaviour towards breast screening. This may mean that it is
249 likely that women are also worried about talking about general breast health issues. Although
250 the current study was specific to breast issues in horse riders, it has highlighted that there is a
251 need for greater education about breast issues to increase confidence and break down social
252 stigmas. If talking about these less serious, but equally important issues of bra fit, breast pain
253 and breast support, becomes normal, women may then be more willing to raise health concerns
254 or access breast screening services in future.

255 There seems to be a gap in school curriculums and public health sources for more generalised
256 information about breast health. In this study, the majority of participants were between 18 and
257 21 years old. This may explain the significant increase in comfort when talking about breast
258 issues post-talk; older females may be less impacted by the educational talk **as they are already
259 more comfortable in discussing these issues** although further research is warranted. However,
260 these results show that, similarly to Brown *et al.* [25], female adolescents are an ideal target
261 group for promoting breast health awareness.

262 Participant’s knowledge of bra fit, breast support and breast pain significantly increased after
263 listening to the educational intervention; those classed as larger breasted increased their
264 knowledge more than those classed as smaller breasted, but only by 0.1 of a score. Generally,
265 larger breasted women experience more breast issues such as pain and embarrassment from
266 excessive breast movement [24]. It was therefore assumed that larger breasted participants

267 would have already had better knowledge of the issues because of personal experience,
268 however this research highlights that educational interventions are required for female riders
269 of all breast sizes. Those respondents that reported no breast pain when horse riding increased
270 their knowledge more than those that did report breast pain, suggesting that female riders who
271 had not experienced breast pain may be more in need of educational interventions at a younger
272 age. Of those reporting breast pain when riding, only 18% (n=2) exclusively wore a sports bra
273 when riding, suggesting that further intervention is warranted in this group as, although they
274 may already have a good knowledge of breast health issues, their bra choices are not necessarily
275 mitigating their breast pain. An enhanced educational intervention would make both groups
276 more aware of the importance of appropriate breast support when horse riding, and may
277 encourage changes in bra choices.

278 Of those riders who reported a positive choice to change their bra choice for riding, all reported
279 already choosing a sports bra for horse riding, but not exclusively, and none had reported
280 experiencing exercise induced breast pain previously. The educational talk may have made
281 them reconsider their reporting of pain in the pre-talk survey, or it is possible that these
282 participants were influenced by some of the links between breast support and rider position
283 [19] presented within the educational talk, so were prepared to change their bra choice to
284 enhance their horse riding performance.

285 There was a strong female bias in this study (95%), which is representative of the sample
286 population of students in equestrian further and higher education programmes. Future studies
287 should aim to increase male respondents as, although the vast majority (91%) of British Horse
288 Society Accredited Professional Coaches (BHS APC) are female, at higher levels of
289 equestrianism nearly 40% of coaches are male [28]. Increased awareness of the breast as a
290 potential problem may enable them to direct their clients to online resources for example where
291 they can find the necessary information to be able to help themselves, thus avoiding difficult
292 conversations. The majority of female participants (83%) in this study also thought online
293 resources would be useful. Encouragingly, nearly half the female participants felt that after
294 hearing the educational talk they would be able to advise others on breast issues, but would
295 still like further information and resources. It may be that this educational intervention was
296 too short, the online nature of the talk did not provide the most effective discussion forum. Or
297 it may be that more supporting resources are required for participants to access at a later date,
298 and further research establishing the best method to impart breast health and issues information
299 is warranted for the equestrian community.

300 The majority of participants wore an everyday bra for horse riding (63%) with only 34%
301 wearing a sports bra, however this was an increase on the previously reported figure of 21% of
302 women that exclusively wore a sports bra for horse-riding reported by Burbage and Cameron
303 [8] and maybe reflective of the differences in age within these two studies with younger
304 equestrians being more familiar with sports bras in general. This is despite research showing
305 that a sports bra is the most suitable bra type to wear when horse-riding to reduce relative breast
306 movement and EIBP [18, 19]. Nearly three quarters of the female participants would rethink
307 or definitely change their bra choice following the educational talk, which confirms the talk
308 had impact, and those that did not want to change their bra were mostly those that already
309 exclusively wear a sports bra when riding. Results suggest that more dissemination of breast
310 health research results within the equestrian community would increase sports bra wear,
311 however consideration needs to be given to the development of equestrian-specific bras as

312 many feel that the bras currently available on the market do not meet their needs for horse-
313 riding in terms of support, fit and style [12].

314 A limitation of this study was that the talks were given online, which makes it challenging to
315 interact and connect with the audience fully. It is clear from the optional post-talk surveys that
316 there was a level of disengagement and although online delivery can be utilised to reach a wider
317 audience, in-person presentation might be more effective in increasing listener participation
318 and the efficacy of both methods should be tested in future. Post-talk surveys were also
319 completed immediately after the educational talks. Ongoing recall memory of the information
320 from the educational talks may be negatively impacted by any emotional response to the
321 subjects covered [29], therefore the addition of a follow-up survey after a period of time has
322 elapsed would be beneficial in any future breast issues educational research.

323 Although on a much smaller scale compared to other similar studies on breast education
324 interventions [22] and tailored specifically to breast health in horse riders, this study has shown
325 that an educational intervention can improve equestrians' knowledge and understanding of
326 breast health issues, **however further research is required to then gauge any subsequent changes
327 in bra choices when riding and any resultant reduction in exercise induced breast pain.** This
328 was a short online presentation compared to Omrani *et al.* [22] in-person, longitudinal study,
329 and should **also** be expanded in future research, **with any long-term behaviour change
330 monitored.** Bra fit and breast support information is rarely included in school health programs
331 [24] and inclusion of breast health education is recommended by Brown *et al.* [25]. For females
332 engaged in horse-riding, there is further potential to educate young equestrians through Pony
333 Club events, British Horse Society campaigns and their coaching pathways, as well as in
334 college and within University equine courses, once the best method of dissemination is
335 established.

336 **5. Conclusion**

337 There continues to be stigma and feelings of awkwardness surrounding the topic of breast
338 health issues in female horse riders affecting people's willingness to talk to others about the
339 breast related challenges they may face. This short educational intervention has been shown
340 to be effective in increasing equestrians' knowledge on breast health issues of bra fit, breast
341 support and breast pain, and increasing their comfort in discussing these issues, **although what
342 impact these changes may have on equestrian bra choice is unknown.** Further research is
343 needed to assess the best dissemination method for educational interventions to the wider
344 equestrian population to enable equestrians of all ages and disciplines to improve their
345 knowledge of breast issues and health when horse-riding.

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347 No funding was associated with this study.

348 **Conflicts of Interest**

349 The authors declare that there are no conflicts of interest.

350 **Ethical Approval**

351 This study received ethical from the Sparsholt Research and Ethics Group. The study complied
352 with guidelines of the Declaration of Helsinki.

353 **Data Availability Statement**

354 The data supporting the findings of this study are available upon request from the
355 corresponding author.

356 **Authors' Contributions**

357 L.C. and R.S. planned and designed the study. R.S. collected the data and carried out the study.
358 L.C., R.S. and M.F. carried out the statistical analysis. R.S., L.C., M.F. and V.L. wrote the
359 manuscript. N.S., L.D. and J.B. reviewed it. All authors read and approved the manuscript.

360

361 **Reference List**

362 [1] Klaperski S, Koch E, Hewel D, Schempp A, Muller J. Optimizing mental health benefits
363 of exercise: The influence of the exercise environment on acute stress levels and wellbeing.
364 *Mental Health and Prevention* 2019;15:200173. <https://doi.org/10.1016/j.mhp.2019.200173>

365 [2] NHS. Benefits of Exercise. 2021. Retrieved from [https://www.nhs.uk/live-](https://www.nhs.uk/live-well/exercise/exercise-health-benefits/)
366 [well/exercise/exercise-health-benefits/](https://www.nhs.uk/live-well/exercise/exercise-health-benefits/) 29/8/21.

367 [3] World Health Organisation. Physical Activity. 2020. Retrieved
368 <https://www.who.int/news-room/fact-sheets/detail/physical-activity> 29/8/21.

369 [4] Mills K, Dudley D, Collins, NJ. Do the benefits of participation in sport and exercise
370 outweigh the negatives? An academic review. *Best Practice & Research Clinical*
371 *Rheumatology* 2019;33:172–187. <https://doi.org/10.1016/j.berh.2019.01.015>

372 [5] Audickas L. Sport Participation in England. 2017. Retrieved from
373 <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-8181#fullreport>
374 20/8/21.

375 [6] British Equestrian Trade Association. National Equestrian Survey 2015. 2015. Retrieved
376 from [http://www.beta-uk.org/pages/news-amp-events/news/national-equestrian-survey-2015-](http://www.beta-uk.org/pages/news-amp-events/news/national-equestrian-survey-2015-shows-increased-consumer-spending.php)
377 [shows-increased-consumer-spending.php](http://www.beta-uk.org/pages/news-amp-events/news/national-equestrian-survey-2015-shows-increased-consumer-spending.php) 21/8/21.

378 [7] Church A, Taylor B, Maxwell N, Gibson O, Twomey R. The health benefits of horse
379 riding in the UK. 2010. Retrieved from [https://research.brighton.ac.uk/en/publications/the-](https://research.brighton.ac.uk/en/publications/the-health-benefits-of-horse-riding-in-the-uk)
380 [health-benefits-of-horse-riding-in-the-uk](https://research.brighton.ac.uk/en/publications/the-health-benefits-of-horse-riding-in-the-uk) 23/8/21.

381 [8] Burbage J, Cameron L. An investigation into the prevalence and impact of breast pain, bra
382 issues and breast size on female horse riders. *Journal of Sports Sciences* 2017;35:1091-1097.
383 <https://doi.org/10.1080/02640414.2016.1210818>

384 [9] Burnett E, White J, Scurr J. The Influence of the Breast on Physical Activity Participation
385 in Females. *Journal of Physical Activity and Health* 2015;12:588-594. DOI:
386 10.1123/jpah.2013-0236

387 [10] Brown N, White J, Brasher A, Scurr J. The experience of breast pain (mastalgia) in
388 female runners of the 2012 London Marathon and its effect on exercise behaviour. *British*
389 *Journal of Sports Medicine* 2014;48:320-325. DOI: 10.1136/bjsports-2013-092175

- 390 [11] White J, Scurr J, Smith N. The effect of breast support on kinetics during overground
391 running performance. *Ergonomics* 2009;52:492-498. DOI: 10.1080/00140130802707907
- 392 [12] Burbage J, Cameron L. An investigation of bra concerns and barriers to participation in
393 horse riding. *Comparative Exercise Physiology* 2018;14:1-9. DOI 10.3920/CEP170030
- 394 [13] Coltman CE, Steele JR, McGhee DE. Does breast size affect how women participate in
395 physical activity? *Journal of Science and Medicine in Sport* 2019;22:324–329. DOI:
396 10.1016/j.jsams.2018.09.226
- 397 [14] Mills C, Sanchez A, Scurr J. Estimating the gravity induced three dimensional
398 deformation of the breast. *Journal of Biomechanics* 2016;49:4134–4137. DOI:
399 10.1016/j.jbiomech.2016.10.012
- 400 [15] Jesinger RA. Breast Anatomy for the Interventionalist. *Techniques in Vascular and*
401 *Interventional Radiology* 2014;17:3–9. DOI: 10.1053/j.tvir.2013.12.002
- 402 [16] John Hopkins Medicine. Anatomy of the Breasts 2010. Retrieved from
403 <https://www.hopkinsmedicine.org/health/wellness-and-prevention/anatomy-of-the-breasts>
404 29/8/21.
- 405 [17] Scurr J, White J, Hedger W. The effect of breast support on the kinematics of the breast
406 during the running gait cycle. *Journal of Sports Sciences* 2010;28:1103-1109. DOI:
407 10.1080/02640414.2010.497542
- 408 [18] Burbage J, Cameron L, Goater F. The effect of breast support on vertical breast
409 displacement and breast pain in female riders across equine simulator gaits. *Journal of*
410 *Veterinary Behavior* 2016;15:81. <https://doi.org/10.1016/J.JVEB.2016.08.020>
- 411 [19] Cameron L, Burbage J, Lewis V, Dumbell L, Billingsley E, Young K, King-Urbin C,
412 Goater F. Breast biomechanics, exercise induced breast pain (mastalgia), breast support
413 condition and its impact on riding position in female equestrians. *Comparative Exercise*
414 *Physiology* 2022;18(1):9-19. <https://doi.org/10.3920/CEP210005>
- 415 [20] Scurr J, Brown N, Smith J, Brasher A, Risius D, Marczyk A. The Influence of the Breast
416 on Sport and Exercise Participation in School Girls in the United Kingdom. *Journal of*
417 *Adolescent Health* 2016;58:167–173. <https://doi.org/10.1016/j.jadohealth.2015.10.005>
- 418 [21] Chen X, Wang J, Wang Y, Gho SA, Steele J. Breast Pain and Sports Bra Usage
419 Reported by Chinese Women: Why Sports Bra Education Programs are Needed in China.
420 *Fibres & Textiles in Eastern Europe* 2019;27,4(136):17-22. DOI: 10.5604/01.3001.0013.1815
- 421 [22] Omrani A, Wakefield-Scurr J, Smith J, Wadey R, Brown N. Breast Education Improves
422 Adolescent Girls' Breast Knowledge, Attitudes to Breasts and Engagement With Positive
423 Breast Habits. *Frontiers in Public Health* 2020;8:591927. doi: 10.3389/fpubh.2020.591927
- 424 [23] McGhee D, Steele J, Munro B. Education improves bra knowledge and fit, and level of
425 breast support in adolescent female athletes: a cluster-randomised trial. *Journal of*
426 *Physiotherapy* 2010;56: 19-24. [https://doi.org/10.1016/S1836-9553\(10\)70050-3](https://doi.org/10.1016/S1836-9553(10)70050-3)

- 427 [24] McGhee D, Steele J. Biomechanics of Breast Support for Active Women. *Exercise and*
428 *Sport Science Reviews* 2020;48(3):99-109. doi: 10.1249/JES.0000000000000221. PMID:
429 32271181.
- 430 [25] Brown N, Smith J, Brasher A, Omrani A, Wakefield-Scurr J. Breast cancer education for
431 schoolgirls: an exploratory study. *European Journal of Cancer Prevention* 2018;27(5):443-
432 448. doi: 10.1097/CEJ.0000000000000356. PMID: 28362651.
- 433 [26] Royal College of General Practitioners. Stigma around women's health must be
434 addressed, says RCGP 2018 Retrieved from [https://www.rcgp.org.uk/about-](https://www.rcgp.org.uk/about-us/news/2018/june/stigma-around-womens-health-must-be-addressed-says-rcgp.aspx)
435 [us/news/2018/june/stigma-around-womens-health-must-be-addressed-says-rcgp.aspx](https://www.rcgp.org.uk/about-us/news/2018/june/stigma-around-womens-health-must-be-addressed-says-rcgp.aspx).
436 10/9/21.
- 437 [27] Vrinten C, Waller J, Marlow L. Cancer stigma and cancer screening attendance: a
438 population-based survey in England. *The Lancet* 2016;338(2):S109.
439 [https://doi.org/10.1016/S0140-6736\(16\)32345-5](https://doi.org/10.1016/S0140-6736(16)32345-5).
- 440 [28] Dumbell L. Profiles of British Equestrian Olympians: Evaluating historical, socio-
441 cultural and sporting influences and how they could inform equestrianism in the future.
442 Doctoral Dissertation, University of the West of England 2022 (Accessed 13 11 23)
- 443 [29] Xie, Weizhen, Chaoxiong Ye, Weiwei Zhang. Negative emotion reduces visual working
444 memory recall variability: A meta-analytical review. *Emotion* 2023; 23(3): 859.