

Evaluation of professional bra fitting criteria for bra selection and fitting in the UK

J. White* and J. Scurr

Department of Sport and Exercise Science, University of Portsmouth, Spinnaker Building, Cambridge Road, Portsmouth, PO1 2ER, UK

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A correctly fitting bra is essential for good health; this study investigates the use of professional bra fitting criteria to establish best-fit in an underwire bra commonly sold in the UK. A comparison was made between women's bra size as measured by the traditional bra fitting method with their recommended bra size based on professional bra fitting criteria. Forty-five female participants were recruited; their mode self-reported bra size was 34DD. Participants were measured in their own bra using the traditional bra-fitting method to establish their 'traditional size'. A 'best-fit' bra size was recorded for participants based on professional bra fitting criteria. Significant differences were found between traditional and best-fit cup and band sizes ($p < 0.001$); the traditional method of bra fitting overestimated band size and underestimated cup size. As band size increased the traditional method also became more inaccurate ($p < 0.001$). It is recommended that women are educated in assessing their own bra fit using professional bra fitting criteria and less emphasis placed on determining absolute bra size.

Practitioner Summary: This is the first study to investigate using professional bra fitting criteria to establish best-fit in an underwired bra commonly sold in the UK. The traditional method of bra fitting was found to be inadequate, especially for larger-breasted women; the use of professional bra fitting criteria should be encouraged.

Keywords: sizing; fit; bra; women; education

1. Introduction

The brassiere (bra) is one of the closest fitting garments worn by women, designed to support and mold the soft tissues of the upper female form (Hardaker and Fozzard 1997). Regardless of how good the design of the bra, if the size is wrong, then it will not provide effective support (Page and Steele 1999). Despite this, it has been suggested that 70 to 100% of women are wearing the wrong-sized bra (Pechter 1998, Greenbaum *et al.* 2003, Wood *et al.* 2008, McGhee and Steele 2010). A correctly fitting and supporting bra is essential to good health; it can alleviate breast pain (Wilson and Sellwood 1976, BeLieu 1994, Hadi 2000, Smith *et al.* 2004), allow women to exercise in greater comfort (Mason *et al.* 1999, White *et al.* 2009) and reduce the need for breast reduction surgery (Greenbaum *et al.* 2003).

In 1935, an American company (Warner[®]) incorporated breast volume into the bra size specification and the alphabet bra was launched, with cup sizes from A to D; this system forms the basis of the modern bra sizing standard we know today (Pechter 1998, Zheng *et al.* 2006). A simple way of communicating bra sizing was necessary for customers, retailers, manufacturers and designers. Two major bra-sizing systems have therefore been universally used since the introduction of Warner's[®] alphabetic bra sizes; the imperial and metric system. The size interval and cup grading of both systems is very similar; the imperial method has been adopted in the UK, whereas most other European, American and Asian countries use the metric system (Zheng *et al.* 2006).

The traditional method of bra fitting using the imperial system relates chest circumference (immediately below the breasts at the infra-mammary fold) to the circumference of the chest around the fullest part of the breasts. To determine band size, an arbitrary number (4 or 5) is added to the under-bust chest circumference (inches). Cup size is then established by calculating the difference between the band size measurement and the over-the-bust measurement (Wright 2002, McGhee and Steele 2006, Zheng *et al.* 2006). Manufacturers often use the cross-grading method when designing bras (Hardaker and Fozzard 1997); this method assumes that adjacent cup sizes across base size ranges are equivalent (e.g. the 34B cup is equivalent to the 36A and 32C, etc.). McGhee and Steele (2006, 2010) and Wright (2002) criticised the traditional bra fitting method as small errors due to rounding numbers up or down in the initial band and cup measurements were calculated to lead to an error of up to three cup sizes; please refer to Wright (2002) for an in-depth review of how bra sizes are calculated.

*Corresponding author. Email: jenny.white@port.ac.uk

The traditional bra fitting method is undertaken in a bra and is still used today by popular retailers (such as Marks & Spencer[®], LaSenza[®] and Victoria's Secret[®]). However, body sizes have changed substantially since the introduction of the alphabet bra, with many UK women now purchasing a D cup bra or larger (Greenbaum *et al.* 2003). As the traditional method of bra fitting was only established for cup sizes up to a D cup (Pechter 1998), the accuracy of this method with sizes larger than a D cup is uncertain.

Bra size itself is difficult to measure and accuracy can be affected by breathing, posture and physical characteristics (McGhee and Steele 2006, Zheng *et al.* 2006, Chen *et al.* 2010, Pandarum *et al.* 2011). International standards suggest that measuring should take place over a well-fitted, unpadded and thin bra, with minimum accessories and support (Zheng *et al.* 2006). Most women are likely to be fitted in a shop whilst wearing their own bra, regardless of whether it meets these international standards; therefore the measurements are not meaningful if the consumer's own bra does not fit appropriately (Greenbaum *et al.* 2003). Bras produced by different manufacturers are also inconsistent in their size (McGhee and Steele 2006), with bra companies using their own size charts and grading methods to size garments (Hardaker and Fozzard 1997).

Breast size and age are two factors that may influence the accuracy of the traditional method. It is particularly important for larger-breasted women (D cup and above) to wear a well-fitted and supportive bra, yet they are more likely to have an incorrect fit due to their breasts being ptotic and bulbous (Pechter 1998, Greenbaum *et al.* 2003, McGhee *et al.* 2006, Wood *et al.* 2008). It is not clear whether there is a relationship between a woman's age and the effectiveness of the traditional bra fitting method. However, ageing causes inferior migration of the nipple (Brown *et al.* 1999) and progressively reduces the relative density of the breast (Soares *et al.* 2002, Haars *et al.* 2005). There is rationale to evaluate whether the traditional bra fitting method becomes less reliable compared to professional bra fitting criteria as a woman gets older and as breast size increases.

McGhee and Steele (2010) presented the first study to challenge methods used to assess bra fit; this study systematically determined the best method for women to independently choose a well-fitted sports bra. The authors compared bra sizes determined using professional bra fitting criteria, with participant's self-selected bra size and one determined by the traditional bra fitting method. The study found that women have a poor ability to independently choose a well-fitted bra and the use of professional bra fitting criteria was promoted by the authors. However, the professional bra fitting criteria presented by McGhee and Steele (2010) have not been compared to the traditional method of bra fitting with an underwired bra commonly sold in the UK.

Larger-breasted women especially may feel self-conscious about being professionally measured and so attempt to fit their own bras; however most women are not trained in this area (Wood *et al.* 2008). Unfortunately, bra fitters within shops have varied experience and there is no agreed level of competency or qualification in the UK (Greenbaum *et al.* 2003). With a lack of knowledge and consistency between manufacturers, it is easy to understand why so many women may be wearing the wrong-sized bra. Limited progress has been made to educate the general public on good bra fit practice in the UK despite the existence of professional bra fitting criteria like that published by McGhee and Steele (2010). McGhee *et al.* (2010) completed a successful intervention with young female athletes where bra fit knowledge increased after receiving an educational booklet. Knowledge of cross-grading has been highlighted in educational material (McGhee *et al.* 2008) but it is not widely available; this information would be useful for women to aid good bra fit practice. Information on common bra fitting mistakes, as well as a clear set of simple criteria to follow to achieve an optimum bra fit, would be valuable.

Therefore, the first aim of this study was to compare women's bra size based on the professional bra fitting criteria (best-fit size) to women's bra size resulting from the traditional method of bra fitting (traditional size). The second aim was to determine the accuracy of the traditional size against the best-fit size as breast size increased. It is hoped that the results of this study will identify common bra fitting mistakes made by UK women, based on differences found between the best-fit and traditional bra sizes. The final aim was to establish the accuracy of the traditional size against the best-fit size as age increased. It was hypothesised that there would be significant differences between participant's best-fit and traditional bra sizes. Secondly, it was hypothesised that as bra size increased the discrepancy between the best-fit and traditional bra size would increase. Thirdly, it was hypothesised that as age increased the discrepancy between the best-fit and traditional bra size would increase.

2. Method

2.1. Participants

Following institutional ethical approval, forty-five female volunteers from a university staff and student population (mean $\pm$ SD: age 32 ± 11.37 years, height 1.65 ± 0.06 m, body mass 67.42 ± 13.02 kg) were recruited for the study via posters and email communication. All participants were aged over 18 years (range: 19 to 58 years), had not

been pregnant or breast-fed within the last year, or had any previous breast surgery; no restrictions were put on the upper age limit or ethnicity of the participants recruited. Participants were asked to attend a single fitting session and to arrive wearing one of their everyday bras (they were not reimbursed for their time).

2.2. Experimental design

Participants were given a verbal explanation of procedures and an opportunity to ask questions. When fully briefed, participants gave written informed consent. Participants then completed a questionnaire, where they reported their age, current bra size and how often they were professionally fitted for bras.

The participant's body mass and height were recorded before the bra fitting commenced. In a private area, participants were then asked to remove their upper body clothing (apart from their bra). Due to the sensitive nature of the topic, participants were measured individually and all procedures were carried out by two trained and experienced female bra fitters who had attended a professional course in bra fitting. If there was a discrepancy in bra sizes between bra fitters, sizing and fitting was repeated until an agreement was reached.

Participants were first measured using the traditional method (Zheng *et al.* 2006); the traditional bra size was established in the participant's own bra (regardless of whether their own bra fitted appropriately) as this reflects procedures undertaken when women are fitted for a bra in a retail outlet. Chest circumference (inches) was measured at the infra-mammary fold with a plastic anthropometric tape (Rosscraft, Canada). Measurements were taken when the participant reached relaxed end expiration (McGhee and Steele 2006). To derive band size, 4 inches were added to an even chest circumference measurement and 5 inches were added to an odd chest circumference measurement (Zheng *et al.* 2006). Cup size was calculated by measuring the circumference of the chest over the fullest part of the breast (bust girth, inches); the difference between bust girth and the band size then dictated cup size (Table 1). To ensure a consistent approach, when participants were measured between two cup sizes the larger cup size was always recorded and when participants were measured between two band sizes the smaller band size was recorded.

The professional bra fitting criteria established by McGhee and Steele (2010) were used to assess the best-fit size for all participants (Table 2). Participants were given the best-selling plain, non-padded, underwired t-shirt bra from the UK's leading lingerie retailer (Marks & Spencer®; made from 88% Polyamide and 22% elastane Lycra®) in the size indicated by the traditional measurement method. One bra style and brand was used to minimise the error associated with fit discrepancy between brands (Hardaker and Fozzard 1997). The fit of this bra was then assessed using professional bra fitting criteria (Table 2). If an adjustment in bra size was needed, the bra was changed until the fit was assessed as correct by both the trained bra fitters using the professional bra fitting criteria.

Figure 1 illustrates some examples of inappropriate bra fit. The most difficult criteria to achieve were the cup and underwire; once the band size was established, a cup size that encased the breast without any bulging, gaping, or

Table 1. Cup size conversion table (Zheng *et al.* 2006).

Bust girth-band size	– 1"	0"	1"	2"	3"	4"	5"	6"	7"	8"
Cup size	AA	A	B	C	D	E	F	FF	G	GG

Table 2. Professional bra fitting criteria (McGhee and Steele 2010).

Band	☐	Too tight: flesh bulging over top of band; subjective discomfort “feels too tight”
	☐	Too loose band lifts when arms are moved above head, posterior band not level with inframammary fold
Cup	☐	Too big: wrinkles in cup fabric
	☐	Too small: breast tissue bulging above, below or at the sides
Underwire	☐	Incorrect shape: underwire sitting on breast tissue laterally (under armit) or anterior midline; subjective complaint of discomfort
Straps	☐	Too tight: digging in; subjective complaint of discomfort; carrying too much of the weight of the breast
Front band	☐	Too loose: sliding down off shoulder with no ability to adjust the length
	☐	Not all in contact with the sternum
Rating of bra fit	☐	Pass: no errors or if hooks or straps can be adjusted to allow correct fit
	☐	Fail: any other tricks

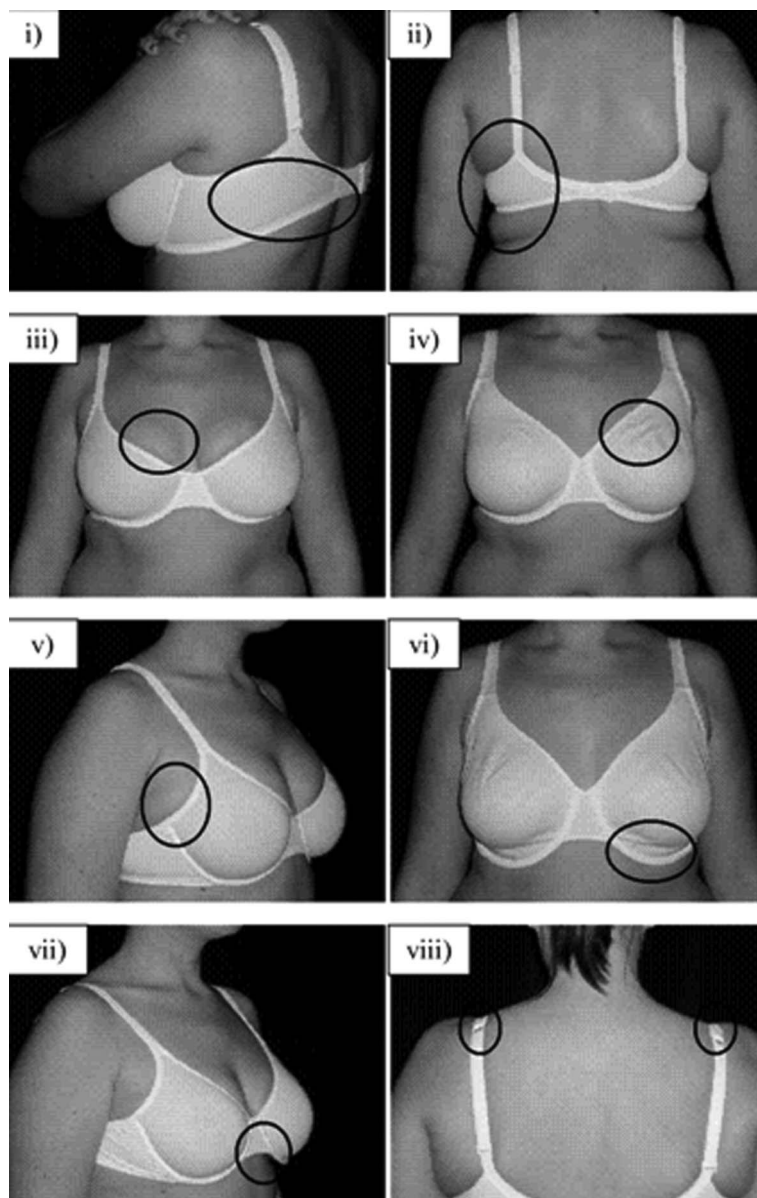


Figure 1. Examples of ill-fitting bras; (i) – Band not level; (ii) – Band too tight; (iii) – Cup too small; (iv) – Cup too baggy; (v) – Underwire resting on breast tissue; (vi) – Underwire resting too low; (vii) – Front of bra pulling away from the chest; (viii) – Shoulder straps digging in.

underwire resting on breast tissue was identified. For some participants, four or five different bra sizes were tried before both bra fitters were confident that the fit met all the criteria in Table 2.

2.3. Data analysis

For analysis, participant's traditional and best-fit bra sizes were converted into numerical scores; cup sizes (range: AA to GG) were allocated numerical scores from 1 to 11 (AA = 1, A = 2, B = 3, etc.) and band sizes (range: 30 to 44 inches) were allocated numerical scores from 1 to 8 (30 = 1, 32 = 2, 34 = 3, etc.). To address hypothesis two, scores for the differential between the best-fit and traditional cup and band sizes (traditional size minus best-fit size) were also calculated for each participant. The differential score was negative if the traditional cup or band size were smaller than the best-fit size, and positive if the traditional cup or band sizes were greater than the best-fit size. Band size differentials ranged from -1 to 5 , and cup size differentials ranged from -8 to 2 . Self-reported bra sizes are

presented but data were not statistically compared with the traditional and best-fit bra sizes obtained due to the variety of bra makes/styles worn by participants.

Statistical analyses of the data were undertaken using Predictive Analytics Software (2009). Data were checked for normality, homogeneity of variance and sphericity. Paired-samples *t*-tests were used to assess differences between traditional and best-fit cup and band sizes. To determine whether the cup and band differential scores (traditional size minus best-fit size) increased as participant's traditional bra size increased, a Spearman's correlation coefficient matrix established the relationships between the traditional cup and band size data and differential scores. A Spearman's correlation coefficient matrix was also used to establish whether the participant's age was related to cup and band size differential scores. An $r_s > 0.7$ indicated a strong correlation and $r_s > 0.4$ a moderate correlation (Fallowfield *et al.* 2005). The alpha level was set to 0.05.

3. Results

Notably, out of the 45 participants, 69% (31) had either never or rarely been professionally bra fitted. Self-reported band sizes ranged from 32 to 44 inches (mode 34 inches) and self-reported cup sizes ranged from AA to GG (mode DD cup).

The traditional method reports a significantly smaller average cup size of around a D cup, compared to almost an E cup established using the best-fit size ($t(44) = -7.143$, $p < 0.001$). A significant difference in band size ($t(44) = 7.187$, $p < 0.001$) was also found between the traditional and best-fit size. For 76% (34) of participants, the best-fit band size was smaller than that measured by the traditional method.

The traditional and best-fit band sizes and the traditional and best-fit cup sizes for each participant are displayed in Figures 2 and 3 in size order (based on the best-fit size). The relationship between the traditional cup and band size scores and the cup and band size differential scores were investigated to determine whether the accuracy of the traditional method was affected by bra size. A significant strong correlation ($r_s = 0.72$, $p < 0.001$) was found between the traditional band size and the band size differential, showing that the

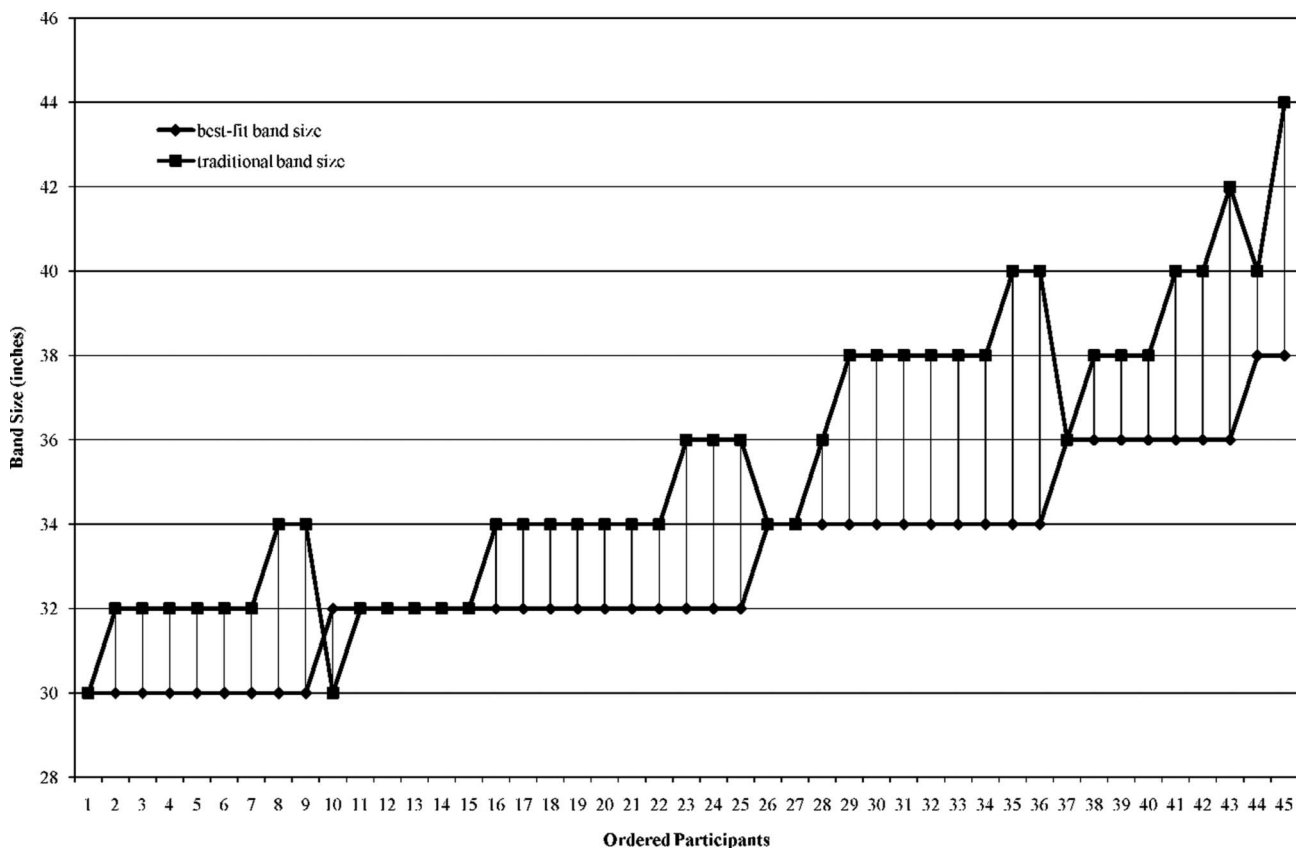


Figure 2. Traditional and best-fit band sizes (participants ordered by best-fit band size).

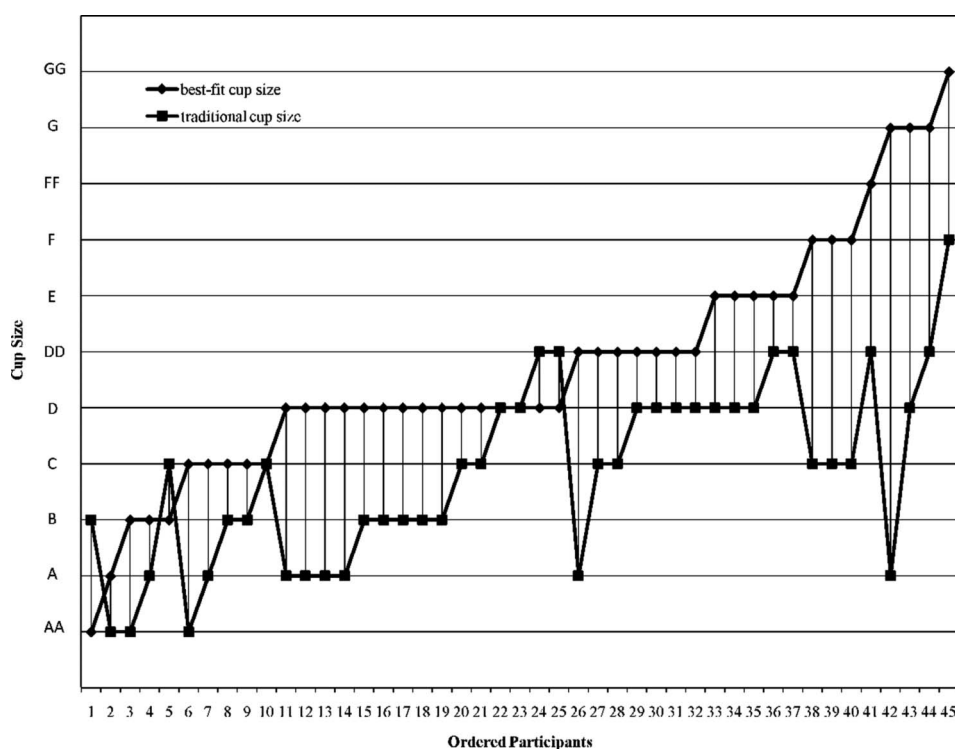


Figure 3. Traditional and best-fit cup sizes (participants ordered by best-fit cup size).

traditional band size increased as the band size differential increased. This suggests that the traditional bra fitting method became more inaccurate compared to using professional bra fitting criteria as band size increased. However, no significant correlation was found between the traditional cup size and the cup size differential ($r_s = -0.256$, $p = 0.089$). Therefore, unlike band size, the traditional cup size was inaccurate compared to the best-fit cup size across all cup sizes.

No significant correlations were found between the age of the participants and the traditional or best-fit cup size ($r_s = 0.050$, $p = 0.746$) or band size ($r_s = -0.060$, $p = 0.693$) differentials, suggesting that the traditional bra fitting method was inaccurate across all ages and did not become more inaccurate as age increased.

4. Discussion

This was the first study to compare professional bra fitting criteria with the traditional method of bra fitting in an underwired bra commonly sold in the UK. Significant differences ($p < 0.001$) were identified between bra fitting methods, confirming findings by McGhee and Steele (2010) in an Australian population and accepting hypothesis one. The best-fit size determined by the professional bra fitting criteria was, on average, one cup size larger and one band size smaller than the bra size determined by the traditional bra fitting method. Similar to McGhee and Steele's (2010) findings, a large percentage (69%) of women in the present study had either never or rarely had a professional bra fitting, therefore suggesting that it is important that women are educated in the criteria of a good fitting bra so they can determine their own bra fit.

Ryan (2000) reported that breast mass should be removed from the shoulders to eliminate pectoral girdle myalgia; therefore a firm, but not uncomfortable, band should be recommended to provide the primary support for the breasts. However, in this study, the traditional method of bra fitting overestimated band size in 76% of women compared to the best-fit band size. This result has implications for women when purchasing a bra after being fitted by the traditional method. Wearing bras with less support in the band will reduce the ability of the bra to support the breasts (Page and Steele 1999).

Due to the relationship between band and cup size, determined by the cross-grading method, wearing a bra with a loose under band may mean that the cup size is too small. This is supported by the results of this study as the traditional method of bra fitting underestimated cup size in 84% of women. An incorrect fit in the cup area may

cause irritation if the bra impinges on the breast tissue (Page and Steele 1999). Educating women on bra cross-grading, so that they understand that when they move up or down a band size their cup size will be affected, may therefore reduce band and cup fit mistakes (McGhee *et al.* 2010).

It has previously been reported in the literature that women were often wearing bras that were too tight in the band and too loose in the cup when comparing the self-reported and traditional bra size (Greenbaum *et al.* 2003, McGhee and Steele 2006, Wood *et al.* 2008); however, the efficacy of studies that have compared these two bra sizes is questionable. Firstly, studies that have utilised the traditional method of bra fitting as a 'gold standard' are problematic as this study has confirmed that the traditional method of bra fitting is not accurate when compared to published best-fit criteria (Pechter 1998, Greenbaum *et al.* 2003, Wood *et al.* 2008, McGhee and Steele 2010). Furthermore, self-reported bra sizes are redundant when 85% of women have been reported to wear the wrong-sized bra when compared to professional bra fitting criteria (McGhee and Steele 2010).

Findings also showed that the larger the band size measured, the greater the difference between the best-fit band size and the traditional band size ($r_s = 0.72$), partially accepting hypothesis two. This suggests that the larger the woman's band size (as assessed using professional bra fitting criteria), the more erroneous the traditional method became. Perhaps excess flesh around the chest in larger women increased the subjectivity of the tape measure reading. This is contrary to earlier findings by Greenbaum *et al.* (2003) who suggested that larger-breasted women were wearing bras that were too tight in the band; yet their 'best-fit bra size' was measured using the traditional bra fitting method.

Inaccuracies in cup size using the traditional method of bra fitting compared to using professional bra fitting criteria were found across all bra sizes, highlighting the need for women of all bra sizes to be wary of using traditional bra fitting techniques to assess their bra fit. This result may not be surprising, considering individual variation in size, contour and density of breasts (Hoffman 2001). It was hypothesised that as participant's age increased, the ability of the traditional method to accurately measure cup and band size would decrease. The results of this study found no relationship between age and fit method, rejecting hypothesis three and suggesting that women of all ages should be encouraged to use professional bra fitting criteria.

When participant's breast size was measured in this study, the common bra fitting mistakes (when compared to professional bra fitting criteria) were that the under band of the bra was too loose and the cup was too tight. The same bra fitting mistakes were reported by McGhee and Steele (2010) for Australian women when self-selecting a bra. Women are therefore urged to ensure they are wearing a bra with a firm under band, and that if they decrease their band size then they may need to increase their cup size. It is important that women realise there may be discrepancies in bra sizing between manufacturers (Hardaker and Fozzard 1997) and that their body shape may influence bra fit (Chen *et al.* 2010, Pandarum *et al.* 2011). A woman's breasts will change size and shape throughout the menstrual cycle and throughout the life cycle (McCool *et al.* 1998, Page and Steele 1999), so frequent evaluation of bra fit is necessary.

To help women select appropriately fitting bras McGhee and Steele (2006) suggested that a new reliable bra sizing system should be developed, which standardises the procedure for calculating cup and band sizes. Currently, bra manufacturers in the UK use their own size charts (Hardaker and Fozzard 2007) and 'fit' varies for marketing and branding purposes, similar to shoe manufacturers (Greenbaum *et al.* 2003). Therefore, insisting all bra manufacturers use the same sizing procedures is difficult, if not impossible, as this would lead to manufacturers losing their identity in the market.

An intervention study in Australia (McGhee *et al.* 2010) confirmed that an education booklet (McGhee *et al.* 2008) given to female athletes significantly improved knowledge of sports bra fit. Future research should look at ways to educate consumers and retailers in the UK on good practice in bra fitting. There is scope to utilise the professional bra fitting criteria within educational material to achieve this aim, perhaps as part of display material in changing cubicles at retail outlets or delivered to school-age children so knowledge of bra fitting is gained at an early age. Future research should also assess to what extent an ill-fitting bra may affect the amount of breast support and breast comfort provided by the bra.

This is the first study to scientifically compare professional bra fitting criteria with the traditional method of bra fitting in an underwired bra commonly sold in the UK. It is recommended that as the traditional method of bra fitting underestimated cup size and overestimated band size in the majority of participants compared with using best-fit criteria, women should subjectively assess their own bra fit using professional bra fitting criteria (Table 2). Larger-breasted women in particular should be wary of using the traditional method of bra fitting to dictate absolute bra size, due to greater inaccuracies in band size as this measure increases. More education is needed so that women can accurately assess their own bra fit. This study recommends that women follow professional bra fitting criteria for appropriate bra fit.

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