

Design and Development of Sports Intimate Apparel - A Review

V. Parthasarathi, T. Raaja Priya, S. Sivaranjani, A. Dhivya

Department of Fashion Technology, PSG College of Technology,

Coimbatore 641004

India

Abstract

It is necessary to evaluate and analyze the brassiere design problems to alleviate the problems in terms of fit, support, elastics and fastening. With an aim to achieve a perfect brassiere, designers have a strong drive to develop a super quality brassiere with high performance and proper usage of components and materials. The encapsulation brassiere was more effective than compression brassiere in controlling breast displacement. The main problems were shoulder straps digging into the shoulder and shoulder straps slipping off the shoulder. There are several design flaws associated with these sports brassiere which lead to discomfort, pain and swelling of the breasts. Tightness around the chest may also cause breast soreness. The straps are often very thin and cut into the shoulders of women. The most effective brassiere had a unique inverted-u shape bounded seam over the upper and side boundaries of the cups with a wide cross-back design. Wicking materials are used in this type of brassieres to give comfort and breast supporting pads having pad components to give adequate support. The inner layer consists of silicone material which can increase the adherence capacity due to its high coefficient of friction. This review paper contains details about the design and development of sports brassiere.

Keywords: sports brassiere, brassiere fit, straps slippage, breast discomfort

Introduction

A study was made to assess the breast considerations of female marathon runners and the results shows the current dissatisfaction with sports bra design and 75% of marathon runners experience brassiere related issues. The frequency of sports brassiere use and the level of importance of sports brassiere use were rated higher during vigorous physical activity compared to moderate physical activity. Engagement with sports brassiere use is high although sports brassiere design could be improved to alleviate brassiere fit issues experienced by female runners (Nicola Brown et al, 2014). Brassiere straps are primary source of discomfort and this study was made to investigate the effects of altering brassiere strap orientation and design. The results showed that brassiere strap discomfort was significantly less in the vertical compared to the cross-back strap orientation. Also the study concluded that the addition of gel pads under the brassiere straps may decrease discomfort and prevent the shoulder straps from slipping (Celeste E Coltman et al, 2015).

For designers of sports brassieres, to ensure these brassieres can reduce force generation and breast discomfort, the wide range of breast masses of women with large breasts is an important consideration. Brassiere breast force is significantly reduced by high support sports brassieres. For a brassiere design, breast mass and force are important biomechanical considerations (Deirdre E.McGhee et al, 2013). Studies have confirmed that many women having larger busts have breast discomfort while exercising and they avoid some exercise. The purpose of this study was to use a systematic design process to the development of sports brassiere prototype for large busted women (Graze Krenzer et al, 2000). A study was made on body surface measurement change in motion using a motion capture system. Here the subject performed an arm rotation test and the measurement changes on the back of the body were focused. The result showed that the shoulder width, back width and back arc at the armpit exhibited the most change (Myunghee Sohn & Elizabeth Bye, 2014).

A study was done to test how the pressure was influenced by different materials at the side strap of brassiere, different test points, body radius of curvature and normal breathing. In this study, the pressure distribution at side straps of brassiere was analyzed by three participants and five brassieres. High pressure brassiere would cause many negative consequences including muscle strain, bones distortion and the internal organs displacement. The higher the pressure is, the greater the damage to women's body. The results indicate that the lower the tensile resistance of side strap material, the smaller the clothing pressure. The

clothing pressure values were bigger where the radius of body curvature is smaller (Lizhuo Wang et al, 2011).

Poor design of brassiere components might cause physical and physiological problems for the human body. Thus there is a necessity to evaluate and analyze the brassiere design problems in order to alleviate those problems in terms of fit, support, elastics and fastening. As breast size and shape vary greatly between individuals, the perfect design of brassiere size and style are important. With an aim to achieve a perfect brassiere, designers have a strong drive to develop a super quality brassiere with high performance and proper usage of components and materials (Cherie Y. C. Chan et al, 2001). A study was aimed to evaluate the shock absorbing performance of different sports brassieres and the factors involved were analyzed. The main parameters were the breast displacement and the reduced percentage of controlled breast displacement (RBD). The encapsulation brassiere was more effective than compression brassiere in controlling breast displacement. A higher brassiere neckline gave more tight compression on the breasts, so more effectively absorbed breast shock (Jie Zhou et al, 2009). Perceived tightness of the sports brassiere around the chest was the most disliked feature in the sports brassiere. Also the main problems were shoulder straps digging into the shoulder and shoulder straps slipping off the shoulder. One report found that up to 70% of female athletes complained of exercise induced breast discomfort during exercises involving running and jumping (Kelly-Ann Bowles, 2012).

Design of sports brassiere

A brassiere includes a pair of shoulder straps and a pair of cup members located generally below the shoulder straps. Each of the cup members includes an inner contact layer substantially completely covering the breast of a wearer, and an outer compression layer slidably disposed in covering relation to the inner contact layer. An adjustment and securing assembly is disposed between each outer compression layer and its corresponding shoulder strap (US20010019933 A1)

Essentially there are three types of sports brassieres: encapsulation, compression, and combination. Encapsulation brassieres support each breast individually with the use of two distinct cups. Compression brassieres compress both breasts simultaneously, holding them firmly against the body with the use of a firm, stretchy fabric. Combination brassieres provide both compression and encapsulation (Denia Ebersole & Nicolas Perdomo, 2012)



Fig.1. Encapsulation brassiere
(Denia Ebersole and Nicolas Perdomo, 2012)



Fig.2. Compression brassiere

Several different designs of sports brassiere are currently available for women. For example, the Jog brassiere has thin straps which are crossed in the back. The brassiere is designed to squeeze the breasts firmly to the body. The Sport Brassiere is also designed with thin shoulder straps and has a low cut back. Play tops is a crisscrossing brassiere with thin shoulder straps and a wide low cut back. There are several design flaws associated with these sports brassiere which lead to discomfort, pain and swelling of the breasts and/or nipples as well as can cause discomfort and pain of the shoulder and back region.



Fig.3. Sports Brassiere (Jesus Torres, Lucia Li-Akana, Keenan Wyrobek, 2013)

In many cases the design of the brassiere causes excessive squeezing of the breasts tightly to the chest which can cause breast soreness. The straps are often very thin and cut into the shoulders of women, particularly larger and more robust women. In addition, while the brassiere try to provide comfort and support to the breasts, they are not designed to provide any comfort or support for the back muscles which help to support the chest in an upright and better postured position (US6068538 A)

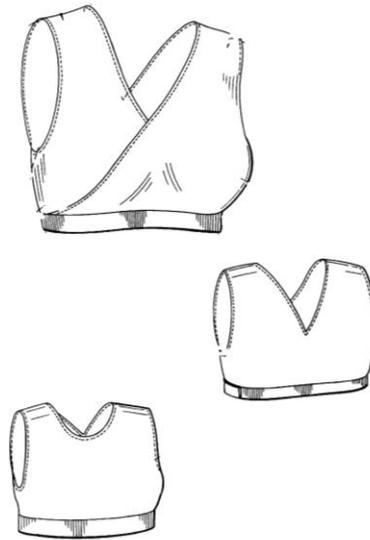


Fig.4. Wrap around sports brassiere (Julia Alleyne, 2000)

The wide strap design had the lowest discomfort scores, significantly lower strap pressure compared to the standard width (2.5cm) and gel strap designs was equally the most preferred design with the gel straps. Brassiere straps that are vertically orientated and wide (approximately 4.5 cm in width) are preferable for women with large breasts during sport and exercise to minimize brassiere strap pressure and discomfort. A vertical bra strap orientation appears to be more suitable for women with large breasts due to the significantly lower strap discomfort and the preference for this orientation compared to the cross-back strap orientation (Celeste E Coltman et al, 2015). The stressful elastic underband would create rashes or oedema due to the poor ventilation and perspiration. Especially for the strapless brassiere, the vertical wiring hugs the breasts with support mainly given by the underband, this will increase the pressure and will hold the underbust uncomfortably.

A study done by Jie Zhou et al, (2013) concluded that the most effective brassiere had the following features: compression type, short vest style, high neckline, slings, cross back, bound neckline, no centre gore, no wire, no cradle, no pad and a non-adjustable wide strap. This provides practical guidelines for brassiere designers and manufacturers to develop more supportive brassiere for women performing these physical activities. The most effective brassiere had a unique inverted-U shape bounded seam over the upper and side boundaries of the cups with a wide cross-back design. The inelastic top front panel was so high that the cups fully engaged the whole breasts. Extensible shoulder straps are more effective in reducing the breast displacement, probably because they stay in contact with the body and keep elevating the breasts during the activities. Improper accessories and fastenings such as

underbands or hooks and eyes on the brassiere can produce the unsatisfactory effects of brassiere design.

Materials used for sports brassiere

Breathable and moisture permeable bra which provides adequate support and high comfort to wear. Wicking materials are used in this type of brassieres to give comfort and breast supporting pads having pad components to give adequate support. And also a wicking layer is adapted to lie adjacent to wearer's skin to pull moisture away from the skin. (Gaudet et al, 2008)

A sports brassiere which includes two cups for breasts, a contact strip and two shoulder straps. The inner layer present in the brassiere is made of silicone material which can increase the adherence capacity due to its high coefficient of friction. (Puyaubreau et al, 2011)

A thermally insulative breast under garment. It may also have a moisture wicking lining structure. It provides a soft-to-the-touch, Warm (or thermally-insulative), supportive sports brassiere or sports type brassiere keeps Wearers dryer and Warmer during sporting activity. (Donnelly et al, 2008)

An athletic brassiere suitable for women runners. It consists of a wide elastic rib band and elastic straps which cross in the back hold the brassiere. Non-irritating material is used and all seams face the outside to provide high comfort. All hardware is eliminated. The cups are not shaped but are they are made of elastic material to pull the breasts in snugly against the body. (Schreiber et al, 1979)

Sports brassieres which consist of one piece back, strong under-bust support, and breast cups. The sports brassiere is of a knitted material made of a combination of 20% Lycra (Spandex) and 80% nylon. The upper cup portion is made of firm Lycra. (Dell et al, 1981)

The brassiere is formed as a one continuous knitted piece with a two way stretch. Additional support is provided by constructing the rear of the brassiere with a height almost that of the front or generally at least 60% of the height of the front. And also a strong elastic band without seams is run continuously around the bottom of the brassiere to provide additional binding and support. (Flanagan et al, 1986)

Protective brassieres and protective inserts are investigated and the brassiere is provided with thin pockets formed from two layers- of fabric with a lateral access opening to receive the insert. The insert has a concave central portion that is substantially rigid with peripheral portions that are flexible in part. The central rigid portion is capable of

withstanding forces of impact and transmitting them to the user's thoracic cage through the more flexible portions. (Mccusker et al, 1986)

The sports brassiere comprises two panel sections called a main body portion with wide strap forming portion and a rear panel section. The rear panel section includes two elastic strap reinforcing bands. The sports brassiere has arm holes and neck hole which are present between the areas of joining front and rear panel sections. (Renelle Braaten et al, 1989)

The covering material used in the sports brassieres can be fabricated by a polypropylene blend and a blend of nylon and Lycra. The harness members in the coverings are made from a non-stretchable, washable material, which can be die cut without fraying. The harness members are fabricated from 100 percent rayon backed with a blend of 50 percent polyester and 50 percent cotton. Alternately, the non-stretchable material can be a blend of 90 percent cotton and 10 percent polyethylene. (Miller et al, 2000)

Conclusion

Increased attention to the comfort and fit performance of the brassiere marks the concern of people about perfect brassiere design. Brassiere straps, cups and underwire are areas commonly causing discomfort. The research done had shown that inadequate support or excessive pressure would cause disfiguration or injury of breasts. Therefore there is a continuous need for design innovation and improvement of bras for rectifying and alleviating those problems.

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