Uplifted: Future Direction in Sports Bras Design

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Background. The benefits of exercise extend far beyond weight management. Regular physical activity can help reduce a person's risk for many health conditions, eliminate stress, and improve the overall quality of life. Lack of a supportive sports bra has been identified as a major deterrent of women participating in sports. There has been a growth in the design of sports equipment and specialized apparel for active women, with a special emphasis on sports bras (Hayes & Venkatraman, 2015). Current developments in fiber and textile technologies, as well as garment construction and manufacturing methods have been employed to improve sports bra design and functional properties, with a flurry of patents filed the past five years. However, eco-friendly sports bras design solutions are commercially inexistent, with brands focusing on enhancing product aesthetics and using moisture management materials.

Literature findings. Correct mapping of consumer functional needs is a key step for the design of sports bras. For women participating in exercise, breast support is crucial, and is the main function of a sports bra. However, the key performance variables that distinguish between levels of breast support during various sport activities are still unclear (Bowles, Steele, &Munroe, 2008). Currently, sports bras are categorized into three groups: (a) encapsulation, (b) compression, and (c) combination of both. Bra straps cutting into or slipping off wearer shoulders, and perceived tightness of sports bra around the chest was found to be common deterrents for use of sports bras (McGhee & Steele, 2010). Moreover, the bra sizing system has shortcomings due to its limited reference measurements used, as well as to its inability to cover a broad range of unique anatomical breast shapes (Bowles et al., 2008). As average breast sizes are getting bigger, studies on three-dimensional (3D) breast movements and performance of sports bras become increasingly important.

Zhou, Yu and Ng (2012) found that various breast motion studies generated inconsistent findings and recommend that women should wear different support levels of sports bras, as needed, for different activities. Regarding the design features of sport bras, the most effective sports bras should have the following features: (a) compression type, (b) short above waist style, (c) high neckline, (d) cross back design, (e) bound neckline edging, (f) no gore panel at center front, (g) no under breast wire, (h) no cradle, (i) no pad, and (j) non-adjustable wide straps (Zhou et al., 2012). Krenzer, Starr and Branson (2005) found that a sports bra should be constructed from primarily non-elastic materials that are non-allergenic, non-abrasive, and have good moisture management properties. McGhee and Steele (2010) proposed the inclusion of thick foam pads inside the bra cups to elevate and compress the breasts in an encapsulation sports bra, to reduce vertical breast displacement and exercise-induced bra discomfort. Evaluating compression using pressure sensors, motion capture cameras, and 3D body scanning technology generates high amounts of data. However, it has been proven difficult to translate compression measurements into breast support efficiency. Seamless circular knitting machinery has been the primary technology used for manufacturing compression sport bras, due to achieving uniform compression levels around the body.

As a garment worn close to the skin, the sports bras are expected to have cooling properties during times of intense physical activity. For example, the innovative temperature-regulating fiber technology Coolcore, is engineered to use the body's own sweat to achieve a cooling effect. Post-millennium fiber innovation has concerns for sustainability: Teijin in Japan created recycled polyester and Cargill Dow developed polylactide polymers from corn (Hayes & Venkatraman, 2015). However, few of these eco-fibers are integrated into commercial applications of sports bras, with most bras being made using polyester, nylon and spandex blends.

Future direction. Digital sensing technologies and new manufacturing methods have allowed engineers to develop new classes of responsive, shape changing, smart materials, using nanofibers and conductive materials (Scott, 2015). Moreover, garment embedded electronics offer new possibilities for enhancing functionality of garments, especially in performance activewear (for example, heart rate monitoring sports bras). However, scalability and feasibility of these technologies is debatable. Recent literature has explored responsive properties of natural fibers aiming to improve functionality of garments (Scott, 2015). Both cellulose and protein natural fibers have dynamic moisture absorption properties. Moreover, a biomimetic systematic design approach of all levels of the textile (fibers, yarns, fabric, and form) needs exploration, rather than applying additional technology to existing fabric substrates. The structure of fabric itself can be designed as a biological inspired responsive system, with minimal waste and ecological considerations, while still having the improvement of the functional properties of the sports bra as an overall goal.

References

Bowles, K. A., Steele, J. R., & Munro, B. (2008). What are the breast support choices of Australian women during physical activity?, *British Journal of Sports Medicine*, *42*(8), 670-673.

Hayes, S. G., & Venkatraman, P. (Eds.). (2015). *Materials and technology for sportswear and performance apparel*. CRC Press.

Krenzer, G., Starr, C., & Branson, D. (2005). Excellence in design–Development of a sports bra prototype. *Clothing & Textiles Research Journal*, *23*(2), 131-134.

McGhee, D. E., & Steele, J. R. (2010). Optimising breast support in female patients through correct bra fit. A cross-sectional study. *Journal of Science and Medicine in Sport*, *13*(6), 568-572.

Scott, J. (March, 2015) Mutate: The Evolution of a Responsive Knit Design System. *In Proceedings of the 2nd Biennial Research Through Design Conference, 25-27.*

Zhou, J., Yu, W., & Ng, S. P. (2012). Identifying effective design features of commercial sports bras. *Textile Research Journal*, 0040517512464289.