

## Performance sports bra for larger busted athletes

Dawn Michaelson, PhD., Baylor University

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**Contextual review and concept.** In sports, performance apparel is highly sought after to achieve enhanced performance while competing (Dickson & Pollack, 2000; Hayes & Venkatraman, 2016; Ho & Au, 2016). Upper body performance apparel, especially for athletes, require proper scapular posturing to achieve consistent performance (Gascon, Gilmer, Hanks, Washington, & Oliver, 2018; Gascon, Washington, Gilmer, & Oliver, 2017; McRoberts, Black, & Cloud, 2015; Zappala et al., 2017). Many athletes, especially throwing athletes, rely on scapular taping methods to achieve this consistent posturing cueing response (Cipriani, Yu, & Lyssanova, 2014; Gascon et al., 2018). To simulate these scapular taping methods in performance apparel, shoulder straps have been integrated to mimic a similar posture cueing response (Cole et al., 2013). Female athletes typically wear a sports bra when competing so integrating posture cueing shoulder straps into the garment would be an ideal solution. Yet, a common complaint among sports bra wearers is shoulder strap discomfort (Brown, White, Brasher, & Scurr, 2014). Additionally, large-busted athletes need more breast support without compromising their feminine appearance through breast compression (Krenzer, Starr, & Branson, 2005; McGhee, Steele, Zealey, & Takacs, 2013; Michaelson et al., 2020; Schultz, 2004; Yu, 2016). The purpose of this garment was to design a feminine posture cueing sports bra for large-busted throwing athletes.

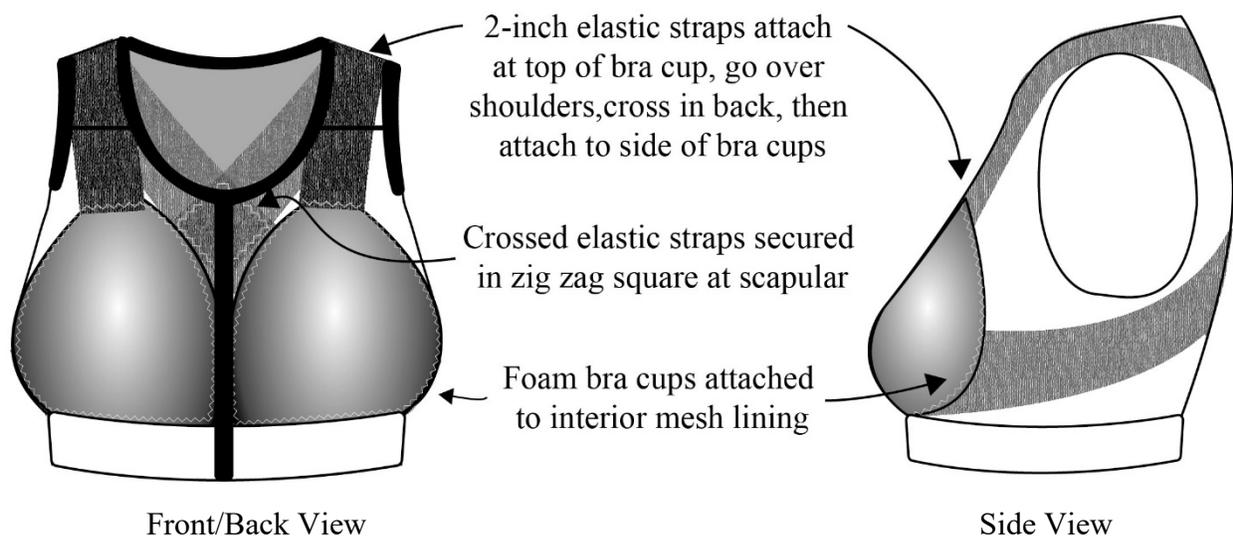
**Aesthetic and functional properties along with visual impacts.** The main fabric of the sports bra features a high-quality polyester/spandex 240 GSM fabric which was digitally wet printed for colorfastness. This design features a geometric design with five different colors. The side insert is made with soft black nylon/spandex 85 GSM power mesh to aid in ventilation and thermal comfort. The 4-way stretch black 110 GSM mesh lining fabric contains moisture management & anti-microbial odor control finishes yet it is still soft, lightweight, and breathable. All exposed edges were bound with fold-over elastic to be aesthetically pleasing and comfortable. The posture cueing mechanism is incorporated between the main fabric and lining. The pattern was designed for a 36" D cup athletic female and features a razorback for increased mobility, especially while throwing. The underarm and front armhole curve was raised so the side breast stays fully encased, and a foam cup was included in the lining for better breast positioning and separation. This provides the desired feminine appearance with less bust compression (Michaelson, et al., 2020). Shoulder straps are wider than typical sports bras and attach at the mid-chest level, not at the shoulder to avoid chafing.

**Process, technique, and execution.** Patterns were drafted for a 36" D cup female athlete based on 3D body scans of twelve female athletes (Shin, 2015; Yu, 2016). The lower underbust band was widened and features 2-inch elastic. Wider elastic under the bust provides better support and less bra movement during overhead throwing activities. The shoulder attachment was relocated

to the mid-chest to avoid chafing. Adjustments to the pattern were made to accommodate the larger bust size and breast tissue distribution while wearing a sports bra. A side panel made of mesh fabric allows for better thermal comfort during performances. The lining is a soft 4-way stretch mesh that encased the posture cueing mechanism and provides a finished interior look to the sports bra and avoids chafing and donning/doffing problems. All fabrics aforementioned are classified as performance stretch fabrics, and research has shown these fabrics improve an athlete's performance (Hayes & Venkatraman, 2016). Seams were lapped and flat seamed on a Juki MF-3620 series industrial machine for increased seam durability and strength. Folded elastic edging was attached using a Juki MF-7900 series coverstitch machine. The posture cueing mechanism is made of 2-inch elastic straps attached to the top of the bra cups, cross and secured at the scapular, then attach to the side of the mesh insert/bra cup, see Figure 1. This posture technique known by bra designers is also used by kinesiologists for improving athletes' posture (Cole et al., 2013; Gascon et al., 2017; Johnson, 2011).

**Figure 1**

*Interior Posture Cueing Mechanism*



**Design contribution and innovation.** Research has shown performance garments aid in enhanced athletic performance yet there are limited apparel options, especially for female athletes with large breasts. While scapular taping is a common practice in sports, having a posture cueing sports bra can provide consistent scapular support during each performance without having to be taped before dressing. This sports bra design builds on prior research in posture cueing and performance apparel for female athletes and was specifically designed for a

large-busted throwing athlete. Patternmaking for large busted and athletic female body shapes is limited in the apparel industry, and this garment provides a platform for continued research in performance apparel for large-busted athletes. The posture cueing mechanism, while proven to improve posture and enhance performance in the athlete has limited research for female athletes or their corresponding bust sizes. This sports bra opens additional research opportunities not only for apparel design but biomechanical applications to improve posture and performance through sports bra design.

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