

Breast Cancer Recovery Product Design Needs Using an Athlete Benefit Model (ABM)

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ABSTRACT

To assist with breast cancer recovery, patients may be recommended to wear a compression bra or top by their physician or oncologic physical therapist. These products often have ineffective thermoregulation, support/compression, fit, mobility, and hand feel, along with being unattractive and expensive. What is unique about these challenges is that they could potentially be resolved through a sports product innovation lens. Sports product manufacturers innovate seasonally to develop products that reduce pain, edema, discomfort, and swelling through targeted support/compression, while addressing thermoregulation, fit, mobility, hand feel, aesthetics, and price. Therefore, the purpose of this study was to utilize a sports product design Athlete Benefit Model (ABM) to determine product needs for female and male breast cancer recovery. Through this work Strengths, Weaknesses, Opportunities and Threats (SWOT) analyses were conducted to determine design opportunities. Moving forward, the research will involve manufacturer identification, materials development, prototyping, sizing, and wear testing.

Keywords: Breast cancer, Product design, Athlete benefits model

INTRODUCTION

Breast Cancer Facts

Breast cancer is a disease where cells grow uncontrollably, negatively affecting healthy cells, and disrupting organ function (American Cancer Society, 2023a; Medical News Today, 2020; National Cancer Institute, 2021). In the United States, 13% of the female population and .12% of the male population will develop breast cancer each year (American Cancer Society, 2023b; Breast Cancer Foundation, 2022). Between 2007 to 2016, breast cancer incidence increased by 0.3% a year, while mortality declined 40% between 1989 to 2017 (American Cancer Society, 2020). As survivorship improves, potential morbidity increases, including immediate and/or chronic pain, swelling, infection, seroma, lymphatic cording, scar tissue issues, nerve injury and lymphedema (swelling disorder). These challenges can cause significant aesthetic, tissue, and biomechanical concerns - many of which are without cure and need proper management. This paper addresses post-treatment care of female

and male breast cancer patients through the evaluation of everyday compression apparel products available on the market using an athlete benefit model (ABM) within a SWOT analysis, to demonstrate how tools used in the sports product design field could inform future recovery products.

BACKGROUND

Breast Cancer Treatment Process

Patients diagnosed with suspected breast cancer must undergo a series of tests to determine pathology, tumor, grading and staging, to devise a relevant treatment plan - which can include biopsy, genetic testing, lumpectomy, mastectomy, radiation, chemotherapy, hormone therapy, immunotherapy, and reconstruction surgery. The biopsy is typically one of the initial tests conducted, where a physician uses a needle to extract tumor, cells to determine cancer type (Mayo Clinic, 2023a). Based on the biopsy results, if further surgery is needed, patients will undergo one or more tumor, excisions, called a lumpectomy (Mayo Clinic, 2023b). This type of surgery removes the tumor, plus a surrounding ring of healthy tissue (Mayo Clinic, 2023b). If the patient decides against a lumpectomy or the pathology/genetic testing indicates a larger surgery is required, a mastectomy is performed to remove breast tissue (American Cancer Society, 2023c). Both lumpectomy and mastectomy procedures may include regional lymph node removal (American Cancer Society, 2023d). In addition, radiation, chemotherapy, hormone therapy, and/or immunotherapy are commonly included as part of the treatment plan, to help stop or slow the growth of cancer cells (Cancer.net, 2023). Some patients may opt for reconstruction surgery for aesthetic purposes. Pain, swelling, infection, seroma, lymphatic cording, scar tissue issues, nerve injury and lymphedema can occur/persist during or after breast cancer treatments. For example, up to 60% of breast cancer patients will experience persistent breast pain, 58% will report persistent peripheral neuropathy, and 24% will develop secondary lymphedema of the arm, breast or trunk; non-Caucasian women are reported to be at higher risk (Bao et al., 2018; Ren et al., 2022). Unfortunately, many of these problems have a lifetime risk of occurrence, post treatment.

Breast Cancer Recovery Product Requirements

To mitigate pain, swelling, infection, seroma, lymphatic cording, scar tissue issues, nerve injury and lymphedema, breast cancer patients are prescribed to wear off-the-shelf products by their surgeon or oncologic physical therapist. These products function by directing compression to the affected area of the body. The most recommended compression recovery products in the United States include gauze bandages, ace wraps, abdominal binders, and a variety of apparel - including, bras for females and tops for males (everyday and sport versions). To assist with fit and function, these products are often modified with shaped foam pads. Compression products can be worn for few weeks or months, while some patients require them for years. To enable functionality and safety, these products should have soft seams (if relevant), fully cover

the affected area, fit appropriately (not too tight or too loose), provide size adjustment, have a soft hand feel through materials, and no underwires or over-complicated design features. For purposes of this research paper, the design of everyday bras for females and tops for male breast cancer recovery will be the focus.

State-of-the-Art Breast Cancer Recovery Bras and Tops

The recovery products selected for this research were based upon brand reputation and usage, as observed by the authors. Two styles were selected for each sex, for analysis. For women, the Prairie Wear Hugger Prima (Prairie Wear, n.d.) and Jobst Belisse Compression (Jobst, n.d.) bras were identified. Basic details of these products are presented in Figure 1. For men, the Marena Short Sleeve Vest (The Marena Group, n.d.) and Leonisa Firm Compression Post-Surgical Shaper Vest (Leonisa United States, n.d.) products were identified. Figure 2 outlines basic details of these products.



Brand: Prairie Wear
 Product name: Hugger Prima
 Price: \$82 USD
 Fiber content: 90% nylon/10% spandex
 Sizes: XS to 2XL



Brand: Jobst
 Product name: Belisse Compression
 Price: \$198 USD
 Fiber content: *polyester/nylon/spandex
 Sizes: 32A/B to 50DD/E

Figure 1: Women's breast cancer bra recovery products selected for analysis.
 *NOTE: Fiber percentages were not provided with marketing materials

Challenges with Breast Cancer Recovery Product Performance

Despite products available to help breast cancer survivors recover from pain, swelling, infection, seroma, lymphatic cording, scar tissue issues, nerve injury and lymphedema – literature and patient feedback indicate these products are inadequate (LaBat, Ryan and Sanden-Will, 2017; Nicklaus et al., 2020; Wroblewski, MacGillivray and Cheng, 2020). Respondents from these previous studies discuss negative side effects, including poor bra wing and under band comfort, lack of adjustability, cosmetic fit, and thermoregulation (LaBat, Ryan and Sanden-Will, 2017; Nicklaus et al., 2020; Wroblewski, MacGillivray and Cheng, 2020). An opportunity lies to approach this challenge through the lens of the sports product design field, where success in innovating products to maximize user comfort, safety and performance is paramount.



Brand: Marena
 Product name: Short Sleeve Vest - MCV/SS
 Price: \$168 USD
 Fiber content: 51% nylon/49% spandex
 Sizes: XS to 4XL



Brand: Leonisa
 Product name: Firm Compression Post-Surgical Shaper Vest
 Price: \$85 USD
 Fiber content: 82% nylon/18% spandex
 Sizes: S to 4XL

Figure 2: Men's breast cancer top recovery products selected for analysis.

METHODOLOGY

Athlete Benefits Model (ABM) for Sports Apparel Design

In the field of sports product design, products are invented to enhance athletic performance, while being safe and comfortable. Because sport products have a multitude of jobs to be done, designers organize their work based upon athlete benefits (Sokolowski, 2019). For sports performance apparel, athlete benefits include thermoregulation, support/compression, fit, mobility, and hand feel.

Thermoregulation is the ability of a product to provide a homeostatic experience for the athlete in a wide range of activities, weather, and temperature conditions. *Support/compression* is the product's ability to apply pressure to specified body zones to reduce muscle vibration, pain, tissue displacement, edema, discomfort and swelling, and/or to improve blood flow. *Fit* is defined as how the product interfaces with the body, and other products – to understand where poor fit interferes, and good fit enables athletic functionality (physically and psychologically). *Mobility/flexibility* is how a product enables the athlete's body to move around within the product and sporting environment. *Hand feel* is the property of a sports product to provide sensory comfort through the softness and smoothness of materials, trims, and construction details. These athlete benefits are indeed aligned to the needs to breast cancer patients in their recovery. Therefore, how can this model be used as a filter to analyze breast cancer recovery products for women and men, to develop action-orientated design plans for future products to improve user performance, safety, and comfort?

Strengths, Weaknesses, Opportunities and Threats (SWOT) Method

To systematically evaluate products, designers often use a SWOT analysis. This method was created in the 1960s by Humphrey, from the Stanford

Table 1. SWOT analysis of women's breast cancer bra recovery products.

Strengths	Weaknesses
<u>Thermoregulation:</u> _Nylon provides cool touch _Bra silhouette (minimum coverage)	<u>Thermoregulation:</u> _Materials do not ventilate/breathe _Materials are heavy/insulative
<u>Support/compression:</u> _Good overall compression _Pockets for pads/prosthetics	<u>Support/compression:</u> _Compression is not tuned _Poor pad/prosthetic pocket shape
<u>Fit:</u> _Fits hourglass body shapes _Size adjustment features _Easy to don/doff	<u>Fit:</u> _Limited sizes _Not inclusive to all body shapes _Interfaces poorly with other apparel
<u>Mobility:</u> _Tank armhole shape _Crew neckline	<u>Mobility:</u> _Adjustment features are small _Chest band placement could restrict
<u>Hand feel comfort:</u> _Nylon has soft/smooth hand	<u>Hand feel comfort:</u> _Rough seams/edges _Thick/stiff trims
Opportunities	Threats
<u>Thermoregulation:</u> _Ventilated/lighter materials _Less spandex/nylon	<u>Thermoregulation:</u> _Access to material technologies _Access to new materials development
<u>Support/compression:</u> _Zoned compression/seamless _Better pad/prosthetic integration	<u>Support/compression:</u> _Access to material technologies _Access to new materials development
<u>Fit:</u> _More sizes/silhouettes _More adjustability	<u>Fit:</u> _Poor size/grading validation
<u>Mobility:</u> _Better armhole/chest band shape _Flexible adjustments/trims	<u>Mobility:</u> _Poor size/grading validation _Inability to develop new trims
<u>Hand feel comfort:</u> _Sanded material backside _Chafe-free seams/trims	<u>Hand feel comfort:</u> _Access to material/trim technologies _Access to new materials development

Research Institute (Lucidchart, 2023). It was developed to bring accountability and objectivity when strategizing around new business opportunities. It is also used widely in the performance sports product industry to analyze existing products in the market and frame-up new design opportunities.

The SWOT is organized through a 2 × 2 grid, labelled Strengths, Weaknesses, Opportunities, and Threats. *Strengths* are positive attributes that are currently evident with the state-of-the-art product. *Weaknesses* are

existing negative attributes that prohibit the product from fully functioning. *Opportunities* are new ideas that can help the product to improve innovation-wise. *Threats* are external factors that could stop the opportunity from happening or present risk of moving the new ideas forward. By organizing a SWOT analysis using the apparel ABM as a filter, the breast cancer recovery products identified by the researchers can be better evaluated for functionality and a clearer path for design can be devised.

RESULTS

Through using the athlete benefit model (ABM) within the SWOT analysis, the state-of-the-art female and male breast cancer recovery products were evaluated (Table 1 and Table 2).

Table 2. SWOT analysis of men's breast cancer recovery top products.

Strengths	Weaknesses
<u>Thermoregulation:</u> _Nylon provides cool touch _Short sleeve/tank silhouette	<u>Thermoregulation:</u> _Materials do not ventilate/breathe _Materials are heavy/insulative
<u>Support/compression:</u> _Good overall compression	<u>Support/compression:</u> _Compression transitions are crude
<u>Fit:</u> _Fits athletic body shape _Easy to don/doff	<u>Fit:</u> _Limited sizes, not inclusive _Interfaces poorly with other apparel
<u>Mobility:</u> _Crew neckline	<u>Mobility:</u> _Stiff zones _Hem rolls up
<u>Hand feel comfort:</u> _Nylon has soft/smooth hand	<u>Hand feel comfort:</u> _Thick/stiff trims
Opportunities	Threats
<u>Thermoregulation:</u> _Ventilated/lighter materials _Less spandex/nylon	<u>Thermoregulation:</u> _Access to material technologies _Access to new materials development
<u>Support/compression:</u> _Zoned compression/seamless	<u>Support/compression:</u> _Access to material technologies _Access to new materials development
<u>Fit:</u> _New silhouettes/sizes _More adjustability	<u>Fit:</u> _Poor size/grading validation
<u>Mobility:</u> _Better sleeve/gusset design _Flexible adjustments/trims	<u>Mobility:</u> _Poor size/grading validation _Inability to develop new trims
<u>Hand feel comfort:</u> _Sanded material interior _Chafe-free seams/trims	<u>Hand feel comfort:</u> _Access to material/trim technologies _Access to new materials development

CONCLUSION

By organizing the SWOT analysis with the apparel ABM as a filter, the breast cancer recovery products were evaluated for their performance, and future design solutions were identified. Interestingly, both the female and male products shared similar strengths, weaknesses, opportunities, and threats. Thermoregulation-wise the current products were made of materials that were hot, heavy and insulative, where knowledge from the sports apparel industry could inform better performing developments. Regarding support, the compression of the existing products could be tuned through materials innovation for zonal support, with better component options for storing/anchoring pads and prosthetics – especially for the women’s products. When it comes to fit, all the products evaluated did not come in a wide enough range of sizes or consider different body shapes (e.g., apple, pear, rectangle, etc.). This is a common challenge in the sports industry, one that companies are currently exploring and improving upon. There was also opportunity for the evaluated products to have improved silhouettes, so they interface with everyday apparel better – to not show-through or peek-out. Regarding mobility, the products could have adjustment features that are easier to manipulate with varying hand dexterities, and on the women’s products the chest band region could be better formed and positioned more effectively so trunk rotation and bending is not encumbered. Most importantly, the products evaluated had very rough/stiff seams, edges, and trims. These can unfortunately could cause chafing and infection – therefore, construction methods used in the sports industry should be referenced for base layers and body wear. Other concerns not addressed with the SWOT include aesthetics and price. The aesthetics of these products could improve, so they feel less medical and more complimentary to the products the user currently wears. Effort should also be made on the development side of the products to reduce manufacturing costs. In the sports industry products at the price points referenced in this paper have much better quality and appeal to the user. Next steps of this research are to utilize the results to design and develop physical prototypes for wear testing and validation by the user. Through this effort the researchers believe breast cancer survivors will have better choices available in the market to assist with their long-term recovery.

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