Cape Peninsula University of Technology

FIT SATISFACTION OF ACTIVE-WEAR APPAREL: EXPERIENCES OF PLUS-SIZE FEMALES IN CAPE TOWN

by

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ABSTRACT

This study underpins the findings of an investigation that inclusive designs of active-wear should be considered by clothing manufacturers and local designers to accommodate plus-size women's body shapes and sizes. This research investigates the validity of an assumption that plus-size women are experiencing problems with fit, including clothing choices and alternatives, perceptions around aesthetics and purchasing behaviour pertaining to active-wear offered by clothing retailers. This research gathered information using both a qualitative online survey given to plus-size females, and practice-led research whereby the researcher developed a prototype to answer the research question through an iterative process. Factors affecting fit were investigated in this study as well addressing the needs of plus-size women to promote body positivity image.

A garment comparison study of active-wear was explored, where the researcher observed and analysed active-wear currently available in stores and conducted a fitting process with plus-size women to identify problem areas regarding fit that could be improved in the development of the prototypes. Factors affecting fit were investigated by examining the current fit, analysing current sizing systems, and testing fabrics used in the design development of the prototype range. The prototype range was evaluated and found to have boosted self-confidence and motivated plus-size women, thereby enhancing body positivity image. Lastly, this research addresses the needs of plus-size women by proposing universal design principles to design inclusive active-wear specifically, and other clothing in general, to accommodate Afro-centric South African women with African body shapes. The literature and the findings from this research have showed evidence that South African clothing retailers use the clothing sizing system from Western countries and that affects how clothing fits - typical South African women in general, especially plus-size females. There is a need for South African researchers in the clothing and textile industry as well as consumer studies to gather and conduct research on South African body shapes to develop a correct and accurate body sizing system to improve the fit of clothing that is offered to plus-size women.

The findings of this study have allowed the researcher to draw possible solutions and recommendations to the research problem and to address the research question. In a way,

this study may potentially influence a way of design thinking and encourage the adoption of universal design principles to improve fit to better accommodate all women in South Africa.

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This research is dedicated to my mother who never finished her lower grades in school because of her poor background and multiple challenges.

Mother, your perseverance, hard work and spirit driven to see your children to succeed produced graduates despite your Grade 4 level of school. Thank you for being a role model in my life: this degree is dedicated to you.

TABLE OF CONTENTS

LIST OF FIGURES

LISTS OF TABLES

ABBREVIATIONS

CPUT – Cape Peninsula University of Technology

PT1 – Participant T1

PZ2 – Participant Z2

PL3 – Participant L3

Size L – Size large

Size XXL – Size double extra-large

MTech – Master of Technology

FID- Faculty of Informatics and Design

CLARIFICATIONS OF TERMS

Active-wear – apparel made for participating in physical activities or sports, although it is increasingly worn in daily activities like shopping or commuting to work, due to the fusion of fashion and fitness (Newcomb & Istook, 2011).

Plus-size females – apparel consumers who dress in clothes size 14 and above (Wang Meng, 2007).

Fit satisfaction – how the garment conforms to the wearer's body (Boordary, 2011).

Size equality – when clothing fit is balanced and everyone has the same rights and opportunities with clothing fit experiences such as comfort (Bishop et al., 2018).

Basic block pattern – a foundation pattern that patternmakers use as a base when drafting patterns.

Final pattern – a styled pattern from which the parts of a garment are traced onto paper before cutting out and assembling (sometimes called 'master patterns').

Anthropometric 3D body scanner – a machine that scans body measurements to produce a picture of a person's body on a computer screen.

Garment prototype – an example of the wearable style developed for this study that sets the bar for additional garments to be created. It includes pattern adjustments and alterations, fabric and specifications of the final design, all the way down to the types of stitching used on every seam.

Universal Design - "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Story, 2001).

Design Thinking - an analysis and creative process where it engages a person to think and experiment and create a prototype or a sample, gather feedback, and redesign (Razzouk & Shute, 2012).

CHAPTER 1: INTRODUCTION TO THE THESIS

1.1 Introduction

The increased level of health awareness globally has resulted in growing numbers of consumers participating in sports activities to achieve a healthier lifestyle (Kercher et al., 2021; Cheng, et.al,2020). The use of active-wear apparel such as tights, tops and sport bras are specifically designed to be worn when one participates in any physical activities. Active-wear is not only worn for sporting activities, but for everyday fashionable use as well. The function of active-wear allows for freedom of movement, is light in weight, regulates body temperature and manages moisture in a variety of body shapes and constructions based on different functional materials that meet specific needs (Stroller, 2021).

Finding active-wear that fits properly and is engineered to ensure predefined performance requirements is a challenge for plus-size females. There is a gap in the clothing and textile market that addresses availability, perceptions and fit satisfaction level of plus-size females regarding active-wear in South Africa (Nkambule, 2010). The focus of this thesis is to address this gap as studies about fit satisfaction of plus-size women are limited (Nkambule, 2010; Pandarum, 2015).

1.2. Outline of chapters

Chapter 1 – Introduction to the Study

This chapter outlines the background of active-wear apparel for plus-size females, presenting the problem statement and research questions and introducing the research study. Relevant literature and guidelines are set within a broader understanding of the researcher on pattern and garment construction.

Chapter 2 – Literature Review

This chapter reviews studies relating to clothing manufacturing and consumer studies in the field of active-wear apparel for plus-size females to outline the current state of the fit and

bring in the universal design principles to be adopted by clothing retailers and local designers. An overview of active-wear, concept of apparel fit, consumer experience and the concepts of universal design are discussed.

Chapter 3 – Research Design/Methodology

The research design and methodologies are discussed in this chapter as they will be used to find answers to the research question. Qualitative email-based surveys serve as the primary tool for gathering data, including asking participants to voluntarily self-identify as plus-size through a poster on social media platforms. The prototype has been designed through practical participation exercises where plus-size women were asked to try on the currently available active-wear, take pictures and give feedback on the overall fit. Next, they were given a prototype to evaluate and take images when performing any physical activity to rate the performance of the garment. **Chapter 4 – Data Collection and Presentation of Findings**

In this chapter, the data collected from the email-based survey with plus-size females and their responses are clarified and presented. Garment comparison findings and a prototype are evaluated and discussed.

Chapter 5 – Discussion and Analysis of Findings

This chapter analysed the findings as presented in Chapter 4. Findings are drawn from the respondents; the evaluation will be analysed and compared to determine if findings support the existing literature. The research problem, as presented in Chapter 1, will be revisited to ensure the outcome of the research is in line with the problem statement and research question and from this alignment, recommendations will be offered.

Chapter 6 – Conclusion and Recommendations for Future Study

Chapter 6 presents the summary of the research; vital information from the literature and the data collected from plus-size females are highlighted. The universal design principles are discussed to determine possible solutions to the present design problem and to benefit further studies pertaining to the clothing and textile industries.

1.3. Background to the research problem

A significant number of plus-size females are active in gyms to keep healthy by exercising. Finding comfortable active-wear that fits properly and performs as expected is a challenge for these consumers (Dabolina, Silina, & Apse-Apsitis, 2018; Greenleaf, Hauff, Klos & Serafin, 2020). According to Christel, O'Donnell and Bradley (2016), plus-size females face challenges when buying clothing, ranging from price discrimination, limited choices, fit satisfaction and an overall discouraging shopping environment. These full-figured women are increasingly aware of the variety of clothing that exists in the market but supplying larger women with these clothes is increasingly problematic (Veinikka, 2015). Even while this segment has been the fastest growing in the fashion industry over the last few years, there is a need for companies to reconsider the variations of active-wear and the offerings available to bigger females (Tullio-Pow et al. 2021). The function of active-wear is to provide comfort

when performing physical activities such as lifting, jumping and bending; hence, it is designed to accommodate the needs of consumers and fit various body shapes (Greenleaf et al., 2020).

Body shapes and sizes of women have been changing while there has not been any change in the sizing standards and garment proportions used in apparel industries (Anderson et al., 2000; Stamper et al., 2005; Pandarum, 2015). This has led to many plus-size women experiencing problems regarding the fit of their clothes. This "depressing" and "frustrating" shopping experience for these consumers has been described in numerous scholarly articles (Anthony, 2019; Chan, 2017; Crockett, 2016). Active-wear plays an important role in motivating and encouraging people to be active and practice a healthy lifestyle. Plus-size women are amongst those seeking a healthy lifestyle. However, studies about their views, experiences and performance of current active-wear offered to them are limited in South Africa (Clevinger, Petrie, Martin, & Greenleaf, 2020).

An opportunity for the researcher to conduct this study is presented by observations and informal interviews with plus-size women who complained about the fit and the performance

of active-wear available in the market. Major issues that were mentioned are that current designs available in the market are inappropriate for their body shapes and do not meet their practical needs, especially tights, as the current design for them has a low back rise which sits below the natural waistline when worn; this affects their performance as tights will drop and reveal their bodies. Another point mentioned is that plus-size women must shop in men's department for t-shirts and vests because the ladies' departments usually lack the large sizes they desire. These issues raised by plus-size women brought to the researcher's attention the need to conduct this study to address negative experiences that affect plus-size female emotions and confidence hinder women from accepting their bodies.

1.4. Statement of the research problem

The problematic gap indicates a lack of consistent sizing which affects the fit of clothing, especially for plus-size females. The lived experience of the researcher (in the roles of student and lecturer) in clothing production and clothing management at a local university of technology has led to an understanding of the problem – a notable gap in the sizing systems used by South African clothing manufacturers and retailers. There is a huge difference in the body measurements taken from plus-size females in Cape Town using Anthropometric 3D body scan compared with the sizing charts in the pattern books that the researcher consulted such as Metric Pattern Cutting for Women's Wear (Aldrich, 2015), The Fascinating Art of Creating Patterns (Defty, 2007), and Patternmaking for Fashion Design (Armstrong, 2014).

The are many factors that can affect fit of any clothing in general, especially the plus-size females. These books that were consulted by the researcher has clearly shown the need to redesign the sizing systems used for South African women. Metric Pattern Cutting for Women's Wear pattern book is widely applied and is based on Western body shapes and published in United Kingdom. Also, the researcher has applied the instructions of pattern making from Metric Pattern Cutting for Women's Wear (Aldrich, 2015).

According to clothing history (Pandarum, 2015), sizing was developed by Americans, British and Europeans. These countries have categorised hourglass body shapes as the ideal figure form to be used; however, body shapes differ on the African continent (Chung, Lin, & Wang, 2007). In South Africa, women's body shapes are different among Nguni, Sotho, Tsonga and

Venda tribes: the prevalent figure form is wide hipped with prominence buttocks (Pandarum, 2015). This glitch allows for the researcher to explore universal design principles as an enhanced framework to address fit challenges and design solutions using design thinking in apparel fit for plus-size females. It is vital for universal design principles to be explored, understood and adapted for use in designing clothing apparel that will accommodate various body shapes regardless of the size they are wearing.

1.5. Researcher's knowledge in the filed

Having worked with different individuals for the past 10 years, the researcher has been constructing patterns using the book entitled *Metric Pattern Cutting for Women's Wear*. This book is also used in academics in the clothing and textile industries. From the researcher's perspective, through observations and consulting with plus-size females to design custom-made garments that include active-wear for them, fit is one of the major concerns they are experiencing when purchasing clothing in retail stores.

According to plus-size females who participated in this study, it was discovered that the clothing available in the market in Cape Town does not meet their needs.

The opportunity is available for the researcher to explore the universal design principles as a framework, addressing fit challenges and design solutions or problem solving for plus-size females. It is very important for the universal design principles to be explored, understood, and adapted for the designing of clothing apparel that will accommodate various body shapes regardless of size they are wearing.

The researcher has gained experience working as a lecturer at the university focusing on Pattern Construction and Garment Construction modules. This work experience has led to a broader understanding in patterns, because during pattern construction, undertaking a prototype to test if the pattern is fitting is essential. Major guidelines for student alteration of patterns were done, especially with students that were plus-size; this formed a solid foundation from which to conduct this study. Through observations in gyms and shopping malls, the researcher is strongly aware and in agreement that indeed there is a need to

address these issues related to fit for plus-size females because there is little active-wear for this niche market and few studies investigating this specific topic in South Africa.

It is critical to hear from plus-size females on their personal views of shopping experiences, the challenges encountered with active-wear currently available in the market and how they rate their fit satisfaction level.

1.6. Research questions

1.6.1. Main question

What are plus-size female experiences regarding fit satisfaction levels, clothing choices and alternatives, including perceptions around aesthetics and purchasing behaviour pertaining to active-wear offered by local clothing retailers?

1.6.2. Sub-question 1

What is the fit problem – if any – with active-wear apparel such as leggings (tights), tops and sports bras for plus-size women in Cape Town?

1.6.3. Sub-question 2

How can the identified problems in apparel design be altered to improve the fit and performance of active-wear apparel for plus-size females?

1.7. Objectives of the research

- To investigate the perceptions and experiences regarding fit satisfaction levels, clothing choices and alternatives.
- To investigate design aspects relating to fit of plus-size active-wear.
- To evaluate the fit satisfaction level with plus-size female active-wear, focusing on problematic areas identified by the participants.
- To develop an inclusive design prototype.

1.8. Research Design and methodology

1.8.1. Qualitative online survey and practical-led research

- **Online survey**

In this study, the researcher investigated the fit problem with active-wear worn by the plus-size market by employing qualitative methodologies (Creswell, 2009). The researcher intended to identify and interpret design issues in plus-size women's active-wear using qualitative research that collects data via online surveys.

- **Practical research**

Thereafter, the researcher conducted a garment comparison of current active-wear by examining three pairs of leggings purchased from three local South African stores to assess fit. Two plus-size female participants wearing size large (L) and double extra-large (XXL) fitted the leggings and give feedback. An anthropometric 3D body scanner was used by the researcher to collect plus-size female's body measurements for the prototype. The body scan extracted images of the body shapes of the selected participants to be analysed to assist the researcher in the pattern-making process of prototype.

Lastly, to get a deeper understanding of the design problem under investigation and to evaluate current active-wear performance, the researcher explored differences across the fit of current active-wear, checking major problem areas. This led to the design development process of the prototype for interpreting the needs of bigger women. Findings are presented in Chapter 5. In addition, the researcher is holistically taking into consideration what the survey reveals about respondents' perceptions, fit satisfaction levels, clothing choices, and alternatives regarding satisfaction with currently available active-wear. This data is valuable since it is practically and clearly demonstrating the differences between what is available on the market for plus-sizes, and the expectations of plus-size females regarding fit satisfaction levels.

1.9. Research methodology flow

1. *Stage one*: Qualitative analysis

1.1. Analysis of relevant literature and current studies regarding active-wear for plus-size females.

2. *Stage two:* Structured surveys with plus-size females.

2.1. Recruit self-identifying plus-size females on social media platforms.

2.2. Online survey with plus-size females.

3. *Stage three:* Practice-led research: the design development of prototype

3.1. Phase 1: Active-wear garment comparison from stores A, B and C.

3.2. Part 1 – Analysis of store leggings without the participants wearing them.

3.3. Part 2 – Analysis of three pairs of leggings when worn by the participants.

4. Phase 2: Anthropometric data: collection of body measurements from plus-size women for the use of developing prototype using 3D body scan.

5. Phase 3: Construction of leggings basic blocks and fittings. This data was also used to analyse findings from the literature review and on the online survey. The manufacturing process of the prototypes helped find commonality and identify clear potential outcomes for the development of active-wear for plus-size females to improve fit.

6. Phase 4: Presentation of the legging's basic blocks

Fitting sessions of the legging's basic blocks with plus-size female participants before the design development of the final prototype range.

7. Phase 5: The styling of the prototype range

Design process of inclusive active-wear prototypes, practical assessment of active-wear performance by capturing images of females wearing active-wear designed by the researcher.

8. Phase 6: Fabric selection for the styled patterns (final prototypes)

Fabrics are sourced from local suppliers in Cape Town and tested at the CPUT Textile Laboratory.

9. Phase 7: Presentation of the technical drawings of final products (prototype range)

The researcher will make technical drawings of the final prototypes using Kalido Style software.

10. Phase 8: Assembly process of the prototype

Specialised sewing machines such as Four Thread Mock Safety Overlocker, Single Lock Stitch Machine and Cover seam machine were used by the researcher in the assembly process of the prototype.

1.10. Research philosophy

1.10.1. Paradigm: pragmatism

The term *paradigm* is used to refer to the field of study in social research and to philosophical assumptions. A pragmatic study aims to bring together different perspectives and beliefs to provide evidence that can be used by a researcher to find answers to research questions (Kaushik & Walsh, 2019). “Pragmatist philosophy holds that human action can never be separated from the past experiences and the beliefs that have originated from those experiences” (Pansiri, 2005: 199). For this study, the pragmatic approach affords the researcher the methods best suited to address this research problem, such as the development of a prototype as a baseline incorporating universal design principles that can be used in myriad ways to address the practical problems associated with fit for plus-size females under investigation.

1.10.2. OntologyThe researcher's point of view has been shaped by the realist ontology which there is a gap that can be studied as researchers, to understand the South African women's body shapes. The researcher conducted a pilot study by asking plus-size women as a foundation for this study as fit is a challenge with active-wear. This study led the researcher to explore universal design principles (Park et al., 2014) to evaluate the fit and satisfaction level of plus-size females in Cape Town, South Africa. The researcher's point of view is also shaped by the currently available active-wear for this sizable market, with interest in investigating more on what is 'unknown' from what is 'known'. This information will encourage future research related to clothing fit for plus-size females and will also benefit South African retailers in reconsidering the current sizing systems employed while considering the possibility of adopting universal design principles to better meet the needs of every women of every size in the country (Feather, 2011).

1.10.3. Epistemology

This study is social research, for which the study design and philosophical assumptions aim to unite various different perspectives and beliefs to provide evidence that plus-size women face challenges in finding a proper fit and comfortable active-wear to accommodate their body shapes. The interpretive paradigm allows the researcher to unpack plus-size females' subjective experiences as individuals, through an in-depth understanding and interpretation of their thoughts, feelings and experiences in an effort to answer the research questions. By using this paradigm, measurement and meaning will both inform the quest to answer the research questions.

1.10.4. Axiology

The importance of understanding ethics in this research is valuable. The researcher understands the nature and role of this study for these larger women and in the clothing and textiles industry. The researcher has taken into consideration that the study was investigating the perceptions or views of plus-size women, which some questions may trigger emotions. Therefore, consent letter that was explained to them had to be signed by the plus-size women. Also, the study was involving fitting session of prototypes and capturing pictures, the researcher must prepare the participants by explaining all the process for this study. The

research methodologies assisted the researcher in remaining unbiased as the study's focus is plus-size females. Recommendations are drawn from survey responses, ensuring that perspectives about fit are presented academically. Literature is referenced to complete the study of plus-size female challenges with active-wear fit and satisfaction with active-wear.

1.11. Ethical considerations

To gather study participants, women were invited on social media platforms such as Facebook, Instagram and WhatsApp and asked voluntarily self-identify as plus-size. The researcher completed all the value approval forms from FID Council before proceeding with the online survey. The explanatory statement was provided for plus-size females who then signed consent letters to indicate that participation in this research was voluntary. Participants were asked to capture video clips and photographs, which the researcher used for study purposes only. Participant privacy was respected, and all participants remained anonymous. The participants were informed about their rights and that the study is only for academic purposes. Withdraw was voluntary at any time during the survey, with no repercussions. As this research was conducted during the Covid-19 pandemic, all policies and regulations were carefully adhered to, and data were collected entirely from an online survey. The design development of the prototype was developed after the pandemic in 2022. This has allowed the researcher to invite the participants that were involved in the design process to visit the CPUT Clothing & Textile Technology station for body measuring and fitting session of the prototype. No incentives were offered to encourage participation in the survey.

The collected data has been stored on Dropbox server and remained so for the duration of the study after which they have been and will remain archived for five calendar years for audit purposes, as required by the Cape Peninsula University of Technology (CPUT). Only the researcher, supervisor, co-supervisor and selected statistician will have access to the data. The researcher has taken into considerations the ethical guidelines and requirements as set out by CPUT. The researcher has treated participant information with confidentiality as well as understood the policies of CPUT regarding research so as to not compromise any participant's intellectual property such as Copyright, Design Registration or Patent.

1.12. Delineation of research

The area of study is specifically related to clothing and textile technology, focussing on active-wear apparel for plus-size females, and investigating fashion for plus-size females and smart textiles used within this field of study. The researcher investigated what is unknown about plus-size females in South Africa using the current active-wear offered by clothing retailers – to better understand fit issues related to active-wear. The researcher has identified garment areas and described the differences between the measurements taken from plus-size females using a 3D body scanner and compared these scans to the sizing charts referenced in the industry book entitled *Metric Cutting for Women's Wear.* The analysis from measurement comparison was used to design a prototype of active-wear for plus-size females to generate possible solutions to the present design problem.

The researcher focused on plus-size women in Cape Town who use active-wear for any physical activity as this allowed to evaluate the performance of this product. The sampling size was kept to 22 participants for the qualitative online study; however, due to the interest of participant during the process of data collection, the sampling size increased to 38 participants. Thereafter, four plus-size females were selected voluntary from amongst the 38 participants to partake in the practical research.

To limit research costs and time to analyse the practical research data, the focus area of the practical research entailed a garment comparison of the current active-wear available in the market, collecting body measurements of four plus-size women using a 3D body scan (Antro-scan) and the construction of legging basic blocks to assess fit through a prototype to address the research problem. The sampling size for the prototype in this study was restricted to women size 18 and larger (Wang, 2007).

The inspiration and design development of an active-wear prototype for plus-size females emerged from the online survey, from the garment comparison of current active-wear, following the *Metric Pattern Cutting for Women's Wear* (6^{th} edition) as a point of reference as starting point of argument when comparing, analysing body measurements and evaluating fit of plus-size females. Smart textiles used to design the prototype were tested in the CPUT Textile Laboratory under the supervision of a textile technician, and garment assembly

techniques for active-wear have been assessed. The researcher has not repeated existing research. The intention is to build upon the existing knowledge for clothing design for plus-size women in South Africa. The prototype was only designed to demonstrate the technical aspect of this research as it was based on clothing design.

1.13. Significance of the study

This research will provide vital information on fit satisfaction levels of current active-wear offered to plus-size females by the South African clothing industry. The information from this research may enable active-wear manufacturers to produce quality and functional plus-size apparel to give them a competitive advantage while valuing the needs of a market that has been neglected for a long time. Apart from market share that active wear apparel manufacturers could gain through understanding the plus-size market, it is also important for plus-size women to feel included and valued within the society, starting with representation in the fashion industry. This will lead to specific design changes and improvements of active-wear apparel such as tights, tops and sport bras using comfortable textiles to achieve a better performance and create size equality for plus-size females in the fashion industry as a whole.

1.14. Chapter summary

Studies related to the experiences of plus-size females associated with garment fit challenges with active-wear are limited in South Africa. This is a starting point for the researcher to investigate, explore and evaluate the current active-wear offerings, interpreting fit challenges of full-figured women with active-wear. This process entails the collecting of qualitative data followed by the practical research. Plus-size females are frequently cross-dressing in men's clothing and presently, the only solution to enjoying a proper fit of clothing is to lose weight. This chapter summarises the literature review, research design and methodologies and practical research that lead to insights from data, the presentation of data, the findings and discussions. Finally, conclusions, significant of the study and recommendations are presented.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter provides a review of the literature on women's plus-size active-wear currently available in the market. Plus-size women's levels of satisfaction with active-wear were investigated including their perceptions and experiences pertaining to active-wear. The following areas that are affecting fit of active-wear offered to plus-size females were investigated and discussed in detail.

- Challenges faced by plus-size women with active-wear. The study will examine current fit, inconsistency of sizing and emphasise the importance of selecting suitable fabrics to improve fit of these garments.
- Practical concerns around active-wear offered in the market.
- Importance of developing inclusive prototypes by adopting universal design principles to improve fit of active-wear offered to plus-size females.

The purpose of developing inclusive designs of a prototype is because plus-size females are restricted from freely performing physical activities, often facing discouragement or demotivation because of ill-fitting active-wear.

2.2. Plus-size females

The term *plus-size* is widely used by the majority of clothing retailers in the clothing industry and in society in general. According to Deborah et al. (2020), the average American woman – including White, Black and Mexican women – wear sizes between 16 to 18 which are categorised as *plus-size*. In South Africa, the average woman wears a size 18 (Cooke, 2019). Parameters that define and classify *plus-size* are unclear, but the phrase is derived from words such as *fat* or *obese* (Dunn, 2016; Christel et al., 2018). Consequently, the criteria which the researcher is using to categorise plus-size females is size 18 above, as the study is addressing issues related to full-figured females (Wang, 2007).

2.2.1. Body positivity image (plus-size women)

In recent years, there has been a shift in the way plus-size women have been represented in the media. Previously in a negative light or largely absent, they are now increasingly portrayed as strong and confident women who are comfortable in their own skin (Pineda & Writer, 2016). For Leboeuf (2019) *body positivity* refers to the movement where plus-size women accept their bodies regardless of size, shape, gender and physical abilities. This body positivity movement is important because it is helping to change the way society views plus-size women. Plus-size women are too often regarded as unhealthy and unattractive, but this is not the case. Plus-size women can be healthy *and* beautiful, and they should be celebrated for their unique bodies. One of the most prominent examples of this shift is the rise of body positivity. Body positivity is all about accepting and celebrating all bodies, no matter the size or shape.

Plus-size women are leading the charge in this movement, sharing photos and stories of themselves that celebrate their curves and their strength (Pineda & Writer, 2016; Leboeuf, 2019). In doing so, they are helping to create a more inclusive and body-positive world for everyone. The body positive movement is breaking down barriers that have been preventing plus-size women from full acceptance in society as well as rejection from the clothing industry. It is empowering women to love their bodies, to be confident in their own skin and to feel good in what they are wearing. This present research is contributing to this movement by embracing plus-size women, boosting their confidence by developing an active-wear prototype range that will make them feel beautiful, strong and amazing with active-wear that fits their curves properly.

2.3. Active-wear

The textile industry active-wear and sportswear market is diverse. Sportswear can range from clothing worn by professional players to active-wear worn by everyday people for exercise or fashion value (Bhattacharya & Ajmeri, 2014). These garments require technical fabrics for performance and comfort. According to Bhattacharya and Ajmeri (2014), as more people adopt healthier lives, more sports have been developed, many traditional sports have grown in popularity, and many more individuals are participating in

a wider array of physical activities, including plus-size women. This growing interest in sports and movement is brought on by a number of societal factors, such as the increase in leisure time, more focus on wellness and good health, the expansion of indoor and outdoor sports facilities, and an increase in adults participating in activities outside of the house or place of employment.

Active-wear refers to clothing items worn for individual sports, fitness lifestyle promotion or for daily activities such as leisure and comfort (Newcomb & Istook, 2011). Fashionable active-wear, a relatively new concept in the active-wear industry, is growing in popularity among consumers (Liu, 2020). Active-wear is designed to allow freedom of movement, be light in weight, regulate body temperature, and manage moisture in a variety of different garment shapes and constructions based on different functional materials that address and meet specific needs (Ho & Chu, 2020). Greenleaf et al. (2019) contend that plus-size females need active-wear with enhanced functionality, that is both fashionable and cater for the identity of plus-size women. In the last half-century, active-wear has trended as a fashion item worn daily. So plus-size female consumers, in becoming more aware of this, also need a selection of these products to be offered in the marketplace (Feather 2011, Bruun & Langkjær, 2016). O'Sullivan et al., (2017) suggest that appropriate active-wear is a need for every individual who participates in any physical activity. However, finding active-wear apparel that is properly fitting and appropriately accommodating the bodies of plus-size females is a challenge (Pisut, & Connell, 2007; Christel et al., 2016; Bickle et al., 2016; Dabolina et al., 2018; Shin & Damhorst, 2018).

2.4. Different types of active-wear

Active-wear is categorised into four groups: performance active-wear, basic active-wear, active-wear-related leisurewear and fashion clothing (Bairagi & Bhuyan, 2021). Active-wear related to fashion and leisurewear is discussed in the study with a focus on particular clothing items: leggings, tops and sports bras. These selected items are worn by individuals at any time of day for comfort or when performing any physical activity, and they also generate positive self-image and lifestyle. According to Horton et al. (2016) and Kollerud and Kvidaland

(2018), consumers want clothing that can be worn from activity to activity, without the need to go home and change.

However, these types of garments tend to have fit issues for plus-size females; for example, the sports bras currently available in the market do not accommodate women with large breasts, as 85.1% of women cannot find the right size and 30% feel like the sport bras do not offer sufficient support (Williams, 2018 &Cheung, 2022). For plus-size females, is it difficult to find the correct size that fits properly: many are uncomfortable, too tight fit and squash the breasts which can ruin a workout (Cheung, 2022). A good sports bra should be soft, stretchy and provide sufficient support, but unfortunately this is a major issue for plus-size females.

2.5. Fabrics used for active-wear

Fabrics used for active-wear are materials designed for high performance or functionality. The function of active-wear apparel is to provide comfort when performing physical activities such as lifting, jumping and bending; hence, active-wear is meant to be designed to accommodate the needs of all sorts of bodies (Nigmatova et al., 2018). Active-wear garments require high performance and lightweight textiles, usually made from synthetic materials such as polyester, nylon or lycra as these are lightweight and breathable (Karthik, Benthilkuma, & Murugan, 2018). These fabrics are designed with wicking properties to keep the body cool and dry during exercise, as well as stretch to allow freedom of movement, making them ideal for exercise (Nigmatova et al., 2018). Textile laboratory tests are extremely important to evaluate the quality of the fabric and assess if they meet quality standards. Laboratory tests such as dimensional stability percentage, stretch and recovery mean, seam strength, moisture management and air permeability are conducted to evaluate the performance of the fabric.

A dimensional stability test is where fabric is tested for dimensional change; for example, if the fabric is reducing its length and width during the washing test, then fabric is checked for shrinkage and stretchability percentage (Aquino, 2021). The stretch and recovery test is when the fabric is tested to determine the stretchability limit and recovery ability. Moisture management is when fabrics are tested for their ability to absorb moisture from

the body to cool the temperature. Finally, air permeability measures the flow of air passing through the fabric during use (Nigmatova et al., 2018).

2.6. Sizing standards in the apparel industry

The South African ready-to-wear clothing sizing system was developed based on an ideal Western body shape, such as the use of the British anthropometric system by some garment manufacturers (Pandarum et al. 2017; Farber, 2018; Bobie, 2022). However, women's clothing sizing is not standardised, and many brands use different sizes to accommodate their target market. The lack of a uniform sizing system by clothing retailers affects the fit for plus-size women (Brown & Rice, 2001). According to Pandarum et al. (2017) and Cooke (2019), the average size of South African women is plus or 'curved', with a bigger bust size, smaller waist and bigger hips. According to Huyssteen (2006) and Strydom (2008), if body measurements of the population are not accurate, all other aspects such as pattern construction, sizing systems and fit will not meet the acceptable standards or proper fit. Seen from this perspective, the South African sizing system is outdated as most clothing retailers adopted and then adapted to a European sizing system. Therefore, it is essential that garment sizing be updated to meet the demands of contemporary consumers (Sokhetye, 2016).

The most common system used by clothing retailers catering specifically for plus-size females is a system called *vanity sizing*. Here, retailers manipulate the sizes, making bigger sizes look like smaller ones to fool women into believing they are wearing a smaller size. This vanity sizing system creates confusion and difficulties for consumers to find the right size or proper fit in stores (Kasambala et al., 2016; Wasserman, 2018). Current sizing systems, which differ from country to country, from shop to shop, and even from one manufacturer to another, have resulted in a wide size variation in the market. The poor sizing systems used by clothing manufacturers create more fit problems, as consumers must try garments on before purchase, or alter the garment before wearing it to ensure that fit is acceptable (Labat & DeLong, 1990). Factors such as size, comfort, functionality, end-use, price and style play a major role in making purchase and wear choices.

2.7. Perceptions of plus-size females

There are very few studies investigating females' perceptions about clothing fit, consumer experiences and issues regarding customer satisfaction with sizing in South Africa (Buttner & Linardi, 2019). Plus-size female consumers often purchase apparel items that do not meet their fitness requirements or age-appropriate styles or fashion (Bickle et al., 2015). The shapes and sizes of women have been changing while there has been no concomitant change in the sizing standards and garment proportions in apparel industries (Anderson et al., 2000). According to Buttner et al. (2019), the fashion industry focuses on fashionable outfits that do not cater for larger sizes, while the average plus-size women globally wear sizes 16 or 18. As a result, many plus-size females experience problems regarding the fit of their clothes. Plus-size females believe that the fashion industry does not understand their clothing needs and their body proportion or shape (Buttner et al., 2019; Lear Edwards, 2015). In South Africa, such studies are not publicised. While some fashion industry houses do individual, ad-hoc surveys, there is an information gap that the academia, such as university research in South Africa, can address through studies of perception, fit satisfaction and emotions felt by plus-size female consumers, and reasons certain emotions affect purchase decisions, wellbeing and self-esteem (Feather, 2011).

2.7.1. Customer expectations and satisfaction

Kadolph (1998) describes *customer satisfaction* as an attempt at assessing how well a product or service meets customer expectations. Customer satisfaction serves as a primary objective of a successful company in a Total Quality Management (TQM) system. Therefore, a company must know and understand its customers to meet their needs. However, customer satisfaction faces one serious difficulty, namely, customers are often unable to communicate the product attributes that are important to them. In addition, customers often judge the products while working with limited knowledge regarding the product and its attributes. The product evaluation process begins with customers purchasing a product and continues with the use of the product; therefore, purchasing decisions are based on customer preferences and experiences (Khedkar et al., 2015).

Customer satisfaction surveys identify issues that impact plus-size female customer satisfaction regarding active-wear (Dasanayake & De Silva, 2020). At times, companies ask customers to assess their performance on the following levels: customer service, friendliness, availability of merchandise, low prices and product durability. Currently, designers and manufacturers have difficulty translating customer expectations into descriptions, characteristics and performance requirements for the products they sell. When assessing customer satisfaction, companies struggle to identify how 'good' is 'good enough' for a product or service (Pandarum et al. 2017; Cooke, 2019; Wasserman, 2018),

Furthermore, customer satisfaction consists of two primary problems: measures of satisfaction are difficult to interpret; and very little information is collected regarding market actions because satisfaction levels and surveys do not address critical issues related to the source of satisfaction or dissatisfaction. Khedkar et al., (2015) explains that retail satisfaction consists of three categories: shopping system satisfaction which includes availability and type of outlets; buying system satisfaction which includes the selection and actual purchasing of products; and customer satisfaction derived from the use of the product. Therefore, according to Khedkar et al., (2015), dissatisfaction with any of the above three aspects could result in customer disloyalty, a decrease in sales, and a diminishing of the market share.

2.7.2. Plus-size females challenges with fit

Many of the studies that address fit satisfaction and consumer experiences of plus-size women report that in most cases women globally cope by cross-dressing when they purchase clothing (Christel et al., 2016; Greenleaf et al., 2020). Cross-dressing is when women purchase clothing items designed for the opposite gender (Christel et al., 2016). Another issue is that plus-size females find it difficult to get the clothing they prefer with the insufficient choices in styles that accommodate certain body types. The use of different sizing systems by clothing retailers is affecting the fit of clothing for women in general, but especially for plus-size females as they feel excluded when it comes to style variety and choice in their preferred clothing: most styles are designed for small customers (Kasambala et al., 2016; Farber, 2018).

2.7.3. Consumer preferences

Many individuals within the plus-size category approach local designers to design custom-made garments that suit their bodies, or resort to ill-fitting and ill-performing garments. These issues raised by plus-size women brought to researcher attention the need to conduct a study to address negative experiences affecting the wellbeing of plus-size females. These discriminatory factors are discouraging this vulnerable consumer group from participating in physical activity, since they also want the pleasure and motivation of wearing properly fitting, stylish active gear.

Framed against the discussion above, clothing addresses a basic need, but in addition, as it plays a part in self-identity, it has formed part of culture and society since times immemorial (Woodward, 1997). People relate to clothing differently; some opt to wear durable clothing to boost their confidence and gain respect in society. Some individuals regard clothing as purely practical and do not overly concern themselves with style and fashion. But in all scenarios, comfort and fit are essential (Mok & Ningrong, 2021). Some feel pressurised by their peers into competitive behaviour, which influences fashion choices and buying habits (Djafarora & Bowes, 2021). Cultural beliefs limit some women, especially married women, from participating in certain physical activities because their tradition prescribes that ‘undergarments’ (i.e., exercise tights and tops) are inappropriate garments to wear in public as they cannot show their bodies to the community.

2.8. Fashion system

The fashion industry forms part of a larger social and cultural phenomenon known as the *fashion system,* a concept that embraces not only the business of fashion but also the art of fashion, its production and its consumption (Manlow, 2018). Clothing is designed to hide the body within the *fashion system* (Romeo & Lee, 2013). Plus-size women have become more aware of the latest fashion trends in the active-wear apparel market yet still find it a challenge to locate active-wear that fits properly. Plus-size fashion styles have changed over time, growing from maternity clothing styles to current unique styles. According to Shin and Damhorst (2018), consumers evaluate fit based on how they feel when they wear a garment, and how comfortable it is for end-use.

Some individuals rate *fit* as an emotional expression of their feelings (Shin & Damhorst 2018). People who have freedom in dress may experience the following positive thoughts: they have control over what they wear; they are capable of choosing between available and alternative clothing; and they experience satisfaction with the choices they have made (Christel et al., 2016). For plus-size females, however, they lack this freedom and confidence in clothing and thus feel dissatisfied with current clothing choices.

Plus-size female consumers express a high level of dissatisfaction with current style trends, let alone trying to match clothing to personal style and tastes (Design,2020). While the experiences and frustrations of the females, particularly plus-size female consumers, towards apparel fit have been studied, there are limited studies that address their perceptions and fit satisfaction (Christel et al., 2016; Markula, 2017). Advice and criticisms of dressing to "emphasize a plus-size female's best features and hide her defects" is a sentiment heard even now (Pounders & Mabry-Flynn, 2021).

According to Wasserman, (2018), it is a challenge for South African plus-size females to find clothing items that fit correctly and are fashionably trendy. Most clothing retailers sell clothing items with the biggest size being XL, which translates to a size 14 or size 38. The sizes currently offered by clothing retailers are mainly even smaller sizes such as size 12, which by many is considered large. But the average woman in South Africa is a size 18, but if a size 14 is XL, then a size 18 is supposed to be XXXL and a size 16 logically should be XXXXL, a rare to find in stores (Wasserman, 2018). Hence, the researcher saw a need to conduct a garment comparison to find evidence of this problem and identify solutions.

2.9. Clothing comfort and functionality of garments

Fit is one of the important factors that influences clothing comfort and garment functionality. According to Runfola and Guercini (2013), *garment fit* refers to how well a garment conforms to a person's three-dimensional body. A comfortable fit is one of the major elements considered in the selection of active-wear. This is because the functionality of a garment is determined by the correct size and consumers use garment fit as means of evaluating the quality of the garment (Muthambi et al. 2015). Proper fit means the garment does not restrict the movements of the wearer while exercising. Every

woman develops her unique style and set criteria with which to evaluate the fit satisfaction of any clothing item, and clothing needs to fit the body of the wearer regardless of size or body shape (Christel et al., 2016). Hence, comfort is felt by the body in terms of movements during physical activities and depends on the individual (Pisut & Connell, 2007; Christel et al., 2016; Shin & Damhorst, 2018; Dabolina et al., 2018).

2.9.1. Different body shapes (figure forms)

According to Alexander et al. (2005), there are four main female body shapes identified within the apparel industry: the hourglass shape, the rectangular shape, the pear shape, and the inverted triangular body shape. Not surprisingly, the inverted body shape has the highest level of satisfaction in terms of garment fit (Alexander et al., 2005: 59). According to research from the University of Pretoria and Tshwane University of Technology, most women in South Africa are pear-shaped (Mason, 2016).

Figure 2.9. 1 Women's body shapes and figures

(Source: Korfiati, 2020)

Clothing retailers are importing 70% of their clothing items to cater primarily to an hourglass shape. According to Pandarum et al. (2017), South African clothing manufacturing is very small and accounts for only 3% compared to other clothing manufacturing companies in other countries such as China. Most South African clothing

retailers source clothing internationally to meet the current need for fashionable women's apparel. Researchers further discovered that "as there are no reports of clothing sizing and fit comparing South Africa and China which is dominating the clothing sector in South Africa, the assumption is that the apparel is not necessarily manufactured for the current body shapes and sizes of South African women" (Pandarum et al., 2017). Poor apparel sizing and ill fit are still an everyday reality for many women today (Kasambala et al., 2014; & Vladimirova et al. 2022).

2.10. Concept of universal design

Park et al. (2014) define *universal design* as products that are designed to accommodate individuals' needs to the greatest extent possible, without the need for modification or specialised design. In clothing, only a few empirical cases have applied the concept of universal design to their design practices (Carroll & Gross, 2010; Carroll & Kincade, 2007, cited in Park et al., 2014). The concept has, however, been used widely by various other design disciplines, such as product design, to better the performance of the artefact to meet the needs of those who have been excluded or denied access by inappropriate design.

The term *universal design* has been used by other authors interchangeably with words such as *inclusive design* (Carroll, & Gross, 2010; Olson, 2018; and Patrick & Hollenbeck, 2021), as they introduce design approaches that are inclusive and barrier-free – approaches that are also explored in this research. Since Park et al. (2014) emphasise the absence of principles of universal design in the apparel field, the researcher explores the seven principles – equitable use, flexibility in use, intuitive use, perceptible information, tolerance for error, low physical effort, size/space for use – and where appropriate, to help address design problems with active-wear apparel for plus-size females. Chauhan et al., (2006) explains that consumers develop a bond with clothing items they buy, during use, and after use. As clothing items become part of one's identity, it is essential for researchers to constantly improve the fit of clothing apparel to suit and reflect individuals' sense of style and preference. Most importantly for this study, active-

wear must conform to a person's physical individuality regardless of age, weight and body shape, and must meet the functional needs of plus-size females.

2.10.1. Garment construction processes

The design development of the prototype in this study requires the researcher to take body measurements for the construction process of patterns. Body measurements can be taken manually using a measuring tape, or by using a 3D body scanner. According to Rose (2021), a 3D scan is a technological software that includes the execution of technical drawings, taking measurements, selecting fabrics, drawing patterns, grading, cutting, sewing prototypes, fit sessions, presentations to clients, evaluating and adjusting until the designer arrives at the desired product. A 3D body scan called *Anthropometric 3D Body Scan* from CPUT Clothing & Textile Technology is used to collect body measurements that are applied to construct patterns to be sewn for the prototype.

2.10.2. Pattern making

A comparison of body measurements is undertaken with the sizing chart from the book *Metric Pattern Cutting for Women's Wear* by Winifred Aldrich (2008). After the body measurements and garment comparison, necessary pattern adjustments are done in preparation to construct a pattern, and after pattern construction, grading is done. Materials suitable for the garment are selected; textile laboratory tests are done; and fabric properties such as moisture management, elasticity, breathability, and more are discussed in the practical research. It is vital to understand the types of fabrics used to design active-wear apparel and to test the performance of the fabric. A prototype of active-wear apparel is designed to test the fit of the pattern.

2.10.3. Garment assembly process

The garment assembly is where the garment is sewn. This follows the pattern making, garment cutting and preparations prior to sewing. The garment assembly process involves sewing together the cut pieces using machines such as mock safety and cover-

seam machines for active-wear apparel. Other sewing techniques included pressing and checking the quality during and after sewing (Glock, 2005).

2.11. Summary

This literature underscores the need to address plus-size female perceptions of currently available active-wear. Most of the plus-size females are cross-dressing in men's clothing as they find it difficult to locate and purchase properly fitting active-wear apparel. They face limited clothing choices, with weight loss typically advocated as *the* solution for differently proportioned and full-figured women.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

This study sought to address the available knowledge to society by investigating plus-size females' views and perceptions about the fit of active-wear; this will also contribute to the clothing industry as clothing stores offering active-wear will gain knowledge about the level of consumer satisfaction of plus-size females. The researcher seeks practical improvements of active-wear for plus-size females, where innovative ideas are developed to address the technical issues of problems identified in the survey. The methodology of executing a research is important in obtaining reliable information. A research methodology is a framework that increases research process efficiency, success and controllable. According to Nayak and Singh (2021), a research strategy, also referred to as methodology, translates ontological and epistemological assumptions into criteria that guide how research should be conducted along with procedures and practices that apply to research. The method for collecting the data and the philosophical assumptions adopted for this study are presented in this chapter.

In this chapter data are collected using two research methods, namely the qualitative method of surveys (Creswell & Poth, 2018) and practice-led research (Niedderer, 2021). Online surveys were used to collect valuable information from a sample group of plus-size female participants to respond to the main research question and the study objectives. Observing and studying samples of active-wear in retail stores resulted in the researcher purchasing three pairs of leggings from three different South African clothing retail stores. This was done to analyse and evaluate the leggings as a basis on which to conduct further practice-led research. The practice-led research component consists of a garment comparison study of current, commercially available active-wear apparel: leggings and tops. Following anthropometric body measurement scans (Rumbo-Rodríguez et al., 2021) of two plus-size female participants, and fabric selection and textile laboratory testing, the design and development of the active-wear prototypes were executed.

3.2. Research paradigm and methodology

3.2.1. Research design

The objective of this study is to address the level of fit satisfaction of plus-size females with active-wear available from Cape Town clothing retailers and to find the best solutions to eliminate fit issues of these garments as this is affecting plus-size females especially those who are active and desire to participate in any physical activity. As explained in the framework in Chapter 2, this research is framed around universal design to answer the research question. This approach addresses the need to design functional active-wear that accommodates all female shapes and sizes to the greatest extent possible without the need for modification or special design. In clothing, only a few empirical cases have applied the concept of universal design to their design practices (Carroll & Gross 2010; Carroll & Kincade, 2007, cited in Park et al., 2014). The concept has, however, been used widely within various other design disciplines, such as product design, to better the performance of the artefact to meet the needs of those who have been excluded or denied access by inappropriate design (Creswell & Poth, 2018).

According to Gupta and Gupta (2011), Kumar (2011) and Saunders, Lewis and Thornhill 2009, *research design* is the objective of a study, important as it shapes the research questions of the study to determine how the questions will be articulated to address the research problem. For this study, a qualitative method is used, where critical evaluation and observations are undertaken by the researcher. Females who regarded themselves as plus-size were initially recruited through social media platforms, with 22 participants were selected; thereafter, 16 additional participants expressed interest and were recruited. In addition to the qualitative online survey, this research is addressing the needs of plus-size females through practical-based research where a garment comparison evaluates the fit of active-wear selected from three different local stores. After analysing the data from the online survey, this garment comparison will assist in the design process of the prototype. This process will include fabric sourcing and fabric testing, an anthropometric body scan (a 3D scanner for body measurements) that will influence the pattern construction of two active-wear outfits. Then, these patterns will be

sewed, tested and evaluated by participants and feedback will be given on fit, style and functionality for the needs of plus-size females.

3.2.3. Research paradigm

The term *paradigm* is used to refer to the field of study in social research and to philosophical assumptions of a study. There are three main research paradigms: qualitative, quantitative and mixed-method research (Gupta & Gupta, 2011:13; Saunders, Lewis & Thornhill, 2009:151). It is imperative for a researcher to understand the research paradigm as it provides guidelines on sampling, data collection and data analysis (Maree, 2017:312). The interpretive framework that is applied in this study is pragmatism. Interpretive frameworks, according to Creswell and Poth (2018), are the theories or views held by the researcher that impact the research process. Creswell and Poth further explain that interpretivism, also called social constructivism, holds no distinction between the researcher and the subject being investigated and that humans can only be understood when observed within their social contexts.

“Pragmatist philosophy is a practical approach that holds that human action can never be separated from the past experiences and the beliefs that have originated from those experiences” (Pansiri, 2005: 199). A pragmatic study aims to bring together different perspectives and beliefs to provide evidence that can be used by the researcher to answer the research question (Kaushik & Walsh, 2019). For this study, the researcher aims to address the needs of plus-size women through an online survey, where these women will share their views to analyse and evaluate fit through practical assessments. A garment comparison will bring evidence to the clothing and textile industry that indeed plus-size females are facing garment fit challenges with the currently available active-wear in the market.

The primary goal of this study is to identify the best solutions for the issues of plus-size females, the poor fit of active-wear that results in discomfort and poor performance during physical activities. This pragmatic approach best suits this study because the researcher is investigating a problem that is not fully understood by the clothing retailers – the perceptions of plus-size females, specifically the African body silhouette. This research

explores the current active-wear available in the market (in Chapter 4) to understand the problems with these garments and why these problems are only applicable to plus-size females in particular and not to other females in general.

3.3. Qualitative research

In this qualitative research, information was gathered from online surveys administered to plus-size females. Qualitative research is more than a set of field methods, data collection techniques or tools, analysis procedures or narrative description. It is also theoretically driven, and a systematic approach to the study of everyday life of a social group which includes a planning phase, discovery phase and presentation phase (Creswell & Poth, 2018). A qualitative email-based survey was used to gather information using an interpretive framework and pragmatic approach that allowed the researcher to investigate and evaluate plus-size women's perception, fit satisfaction level, clothing choices, alternatives if any, and consumer satisfaction with current active-wear.

The problem statement explains that fit of active-wear is a major concern for plus-size females in Cape Town and yet this problem has received scant attention in studies. The hypothesis is that plus-size females face a variety of difficulties when purchasing active-wear, such as a confusing and inaccurate sizing system that makes it difficult to tell what size one is wearing. From store to store, sizes can vary as to how garments fit. For this niche market, there are few options for fashionable active-wear; yet, at some shops, while it is possible for a female to find what she like, prices are then expensive and fit of those garments frequently does not meet the level of satisfaction of plus-size females.

This issue inspires me as a researcher to investigate by conducting a qualitative online survey with the aim of eliciting personal views from plus-size females to see how they feel about the active-wear currently available from South African clothing retailers.

The reality of this research is that plus-size females feel excluded by the clothing industry; they often resort to purchasing any clothing item they can find with few choices that suit their body shapes. As the researcher, I believe that answers to the research question are best obtained from the feedback of the participants themselves. This study holistically

considers what the survey reveals about respondents' perceptions on fit satisfaction levels, clothing choices, and alternatives with active-wear currently available. This in turn will culminate in a prototype responding in detail appropriate to the survey data.

3.4. Sampling

The target population for this study consisted of plus-size females who follow an active lifestyle of physical activities. Even though the use of active wear is shifting to leisure, everyday wear, it is important that the participants be involved in at least one physical activity to ensure that active-wear is purchased and used at some point for the purpose of exercising. Purposive sampling was used to select 38 plus-size females between 18 and 42 years of age who are based in Cape Town, South Africa, specifically with African body silhouette.

The selected women participated voluntarily in the survey. The reason for this purposive selection process online was to solicit participation from females across many demographics, to ascertain if females from different demographic groups perceive sizing similarly and whether they categorise plus-size differently. During the process of collecting the data, African females were interested in participating in the study, and as a result, the data collected successfully represents the African body silhouette. In the design development process of a prototype, the researcher selected participants who are wearing size large (L) and double-extra-large (XXL). The purpose of this selection is to determine the outcomes, as these sizes are the most challenged in terms of fit.

3.5. Data collection presentation

The researcher investigated, analysed and drew conclusions using qualitative online surveys. A poster (see Appendix A) posted on social media platforms was employed to recruit women who participated voluntarily in the study, with the goal of obtaining responses from full-figured women. The women had to self-identify as plus-size to participate in this study on fit problems or challenges faced by plus-size females with current active-wear on the market. The reason for this criterion is because there are no specific parameters that define plus-sizes; however according to literature, the term *plus-*

size includes size 14 and above (Dunn, 2016; Deborah et al., 2020). The initial sample size was 20 participants, but due to the number of interested plus-size females, the researcher received a positive response from 38 participants.

After identifying the plus-size female participants, the researcher contacted the participants and requested permission to add their numbers on a WhatsApp group to create an easy communication platform between participants and the researcher. The other aim for this WhatsApp group was to request email addresses from the participants to send the link of the survey designed on Google forms. The survey was explained as well as the timeline and deadline by which the researcher expected to finish collecting the online survey. From the pool of 38 participants, two plus-size women were selected who volunteered to participate in the practice-led study. The researcher explained to the participants that the online phase will be followed by the design development of the prototype, wherein these two women are needed.

3.5.1. Interview structure in the online survey

The researcher designed a structured, open-ended, Likert-scale questionnaire using Google forms (see Appendix C). The researcher also prepared consent forms that were distributed to the participants (see Appendix B) prior to conducting the survey. The respondents were from Cape Town, South Africa. The survey started on 8 of August 2022 and completed on the 15 August 2022. The Likert scale had five questions that were answered in two methods: the first question asked participants to rate the overall fit satisfaction or active-wear as (1) bad (means they are not satisfied), (2) poor, (3) moderate (or, neutral), (4) good or (5) excellent (means they are satisfied with the fit of active-wear). For the other four statements, the participants had to rate fit satisfaction level of active-wear leggings, tops, sport bra and the overall shopping experience from (1) Strongly Disagree (means they are not happy with active-wear available and they do not enjoy the shopping experience), (2) Disagree, (3) Neutral (means they are in-between with reasons as to why) (4) Agree and (5) Strongly Agree (means they are happy and they do not perceive any problem).

Open-ended questions allowed the respondents to share their concerns about active-wear currently available on the market. The researcher was able to obtain valuable data about fit and the experiences of plus-size females with sizing, comfort, performance, fabric choices, style preference, recommendations and suggestions regarding current active-wear for the fuller figure. This data subsequently influenced in the process of designing and developing prototypes to improve the fit of active-wear in this category.

The questions were created to identify and evaluate challenges that plus-size women have in finding active-wear that fits them properly and accommodates their larger bodies comfortably for optimum benefit when exercising. During the recruitment and the selection processes, the researcher did not experience any problems in selecting plus-size women, since many women were interested in participating in this study. The only challenge experienced by the researcher was to find a more diverse plus-size women group of different ethnicities. Thus, 99% of the participants were from the African group.

3.5.2. Questions used in the online survey

The questionnaire had two sections, namely, Section A and B, to obtain data from the participants. Section A consisted of Likert-scale questions where plus-size female participants rated their overall fit satisfaction level of active-wear offered by South African clothing retailers. These questions focused on active-wear tops, sport bras and leggings. Section B consisted of open-ended questions for participants to elaborate on their personal views regarding fit of active-wear. This included what good fit meant to them and the criteria they adhered to when purchasing active-wear. They also identified garment areas with which they experienced most problems with fit. The researcher provided guidelines of the garment areas to explain the survey before participants even started answering questions.

The researcher explained the garment areas that were listed on the survey so that participants could respond with a clear understanding of the questions. The garment areas presented in the survey were bust, waist, hips, bicep, and front and back crotch line measurements. The primary reason to focus on these garment areas was to guide the researcher in the process of design and development of the prototypes that would better

accommodate the needs of plus-size women. Based on the responses from the online survey and informal interviews, it was clear that most women who experience fit problems are larger women who wear sizes large (L) and above.

3.6. Practical component of the research, the design development of prototype

Practice-led research in clothing design is a process of inquiry informed by both practical and theoretical aspects of design (Engine, 2021). Practice-led research is growing in popularity in the field of design (Sade, 2021), and in particular clothing design, as it allows designers to explore the potential of their designs in a real-world setting. It focuses on the application of design principles, provides valuable insights into how people interact with clothing, how clothing affects their mood and behaviour, and what sorts of design improvements will make a garment more effective (Engine, 2021 & Sade, 2021). There are several ways to conduct practice-led research, but one of the most common is to create a prototype of the design and test it out in the field (Engine, 2021). Consequently, the researcher has undertaken a series of iterative explorations where different phases are built from findings from the previous phase as they link and support each other.

The researcher used this method to further investigate fit and fit satisfaction of active-wear offered to plus-size women. Through the exploration of designing prototypes, testing the designs and getting valuable feedback from the participants to ensure that active-wear for plus-size women may be designed for practicality and effectiveness, and during the testing phase with necessary adjustments to improve fit, the practice-led approach was highly appropriate. In addition, the researcher sought to explore the relationship between clothing design (active-wear) and how it fits to the bodies of plus-size women seeing that these garments are figure hugging and need to support the body in different active positions without causing strain, discomfort, pulling or stretching (Zong, 2022).

The practice based method was informed by theoretical concepts and knowledge in literature (Sade, 2021). This method is iterative – theory led to practice and practice to theory. From the online survey, data was gathered which in turn informed the design and development of the prototypes. The research followed eight different phases to investigate, design and prototype new design concepts based on inclusive design

methods as a subset of universal design principles (Park et al., 2014; Ariff et al., 2022) that were specifically incorporated to improve fit.

After analysing the data from the online survey, the researcher purchased tops and leggings from three of the largest clothing retailers in Cape Town, and compared the quality of the materials used, the cost of each item, the style, and how well it suited various body types. To assess the fit, the researcher selected two participants to try on these samples from three stores and provide feedback. The researcher selected plus-size females who wear large (L) and extra-large (XXL). The main reason for choosing these two sizes was to address the situation of one size fitting differently from various stores to show how size discrepancy affects full-figure women.

The researcher specifically examined how these garments fit on garment areas such as bust, waist, hips and body rise. The major concern that was mentioned by this niche market is that the available leggings fit uncomfortably: women buy a garment that has a tag claiming it to be high waisted leggings, but the fit sits on the lower waist line instead of fitting comfortably on the natural waistline. Data were collected from the online survey and from the garment comparison of three pairs of leggings from the three clothing stores. The research intends to rectify these practical issues by designing a prototype range. The design development process will address and suggest the needs of plus-size females that can be taken further by future studies. The researcher has followed the design development phases used in clothing manufacturing.

Phase 1: Active-wear garment comparison from Stores A, B and C will be demonstrating those issues in Chapter 4.

Part 1 – Analysis of store leggings without the participants wearing them.

Part 2 – Analysis of three pairs of leggings when they are worn by the participants.

Phase 2: Anthropometric data – collection of body measurements from plus-size women for the use of developing a prototype using a 3D body scan.

The second phase involved an anthropometric 3D body scan, where the researcher invited Participant T1 and Participant Z2 for scanning body measurements that would be used to design the prototype. For the control of the study, initially the researcher invited four plus-size women who wear sizes from medium (M) and above; however the researcher reduced this number to two plus-size females who wear size large (L) and double extra-large (XXL). As mentioned in Phase 1, these plus-size women selected are the only sizes that admitted problems with the perfect fit. Another reason for selecting these particular women was that while the recruiting process of the survey was online, so with practice-led research took time, and most respondents mentioned that because of their busy schedule working and studying, it would be difficult to come to the Bellville campus for fitting sessions. Therefore, the researcher selected the participants who lived closer and who were able to attend fitting sessions of the leggings and the anthropometric 3D body scan session (Yan, Wirta & Kamarainen, 2020). As the researcher has mentioned in the ethical clearance, all participants had the right to withdraw anytime in this study, so the researcher continued with two participants who were willing to partake in all the phases of the practical research.

The researcher organised the 3D body scan at the CPUT Clothing & Textile Technology Station on 30 August 2022. The aim with these two women was to take their body measurements as plus-size females for the purpose of developing active-wear prototypes. There are different ways to take body measurements, such as by a tape measure, which is the most common method of local designers and students. However, another method used, categorised under ‘smart technology’, is the body scanning method named anthropometric 3D body scanner (Rumbo-Rodríguez et al., 2021) which scans the entire body to captures the body image to determine a women’s type of body shape.

The 3D body scanner was used for capturing accurate body measurements and to analyse the different body shapes of the two participants. The anthro scan (3D body scanner) is located at the CPUT Clothing & Textile Technology station, and the participants were willing to come to the venue. They were informed to wear or bring under garments such as tights and tank tops or vests during the process of body scanning to allow the machine to scan the body properly without disruption from bulky clothing items.

The researcher was assisted by technician Ms L VR who is experienced operating the machine.

The technician demonstrated how the body scan works and showed how the participants should position themselves during the scan. The participants were informed that these measurements are taken to design the active-wear prototypes and they will be invited again to the fit session of the leggings basic blocks as the researcher used their body measurements in the pattern construction process. Phase 3 entails the construction of the basic block of leggings. A basic block, also called ‘Sloper’ or block pattern, serves as a foundation to develop a pattern and design new patterns for garments (Huang, 2012). The research designed a range of active-wear leggings sizes large (L) and double extra-large (XXL), which required the researcher to first construct the basic block to then design a flat pattern. This process is discussed in phase 3.

Phase 3: Construction of legging basic blocks and fittings.

Patterns blocks are constructed following the book *Metric Pattern Cutting for Women’s Wear*, and adaptions will be made from this block during the styling process as the book states that there is no ease for comfort or movement. The legging blocks are constructed from the *Metric Pattern Cutting for Women’s Wear* as well. Pattern adaptions from work-plan to final patterns are constructed and tested and pattern adjustments are made. Finding are discussed in Chapter 5.

Phase 4: Presentation of the legging basic blocks

Fitting sessions of the legging basic blocks with plus-size female participants before the design development the final prototype range.

Phase 5: The styling of the prototype range

The designing and pattern construction process of four leggings and matching tops.

Phase 6: Fabric selection for the styled patterns (final prototypes)

Fabrics are sourced from local suppliers in Cape Town. Fabrics will be tested for fabric stretch and high-performance fabrics for comfort such as breathability of the materials. All fabrics used for the protype are tested at the CPUT Clothing & Textile laboratory. The results of the fabrics are presented in Chapter 4 and analysis is presented in Chapter 5.

Phase 7: Presentation of the technical drawings of final products (prototype range)

The researcher will make technical drawings of the final prototypes using Kalido Style software. The technical drawings will show both front and back view of the garments.

Phase 8: Assembly process of the prototype

Specialised fabrics and threads were sourced locally to design this prototype. For the sewing process of the prototype, specialised machines used for this production include the mock safety four thread overlocker, plain stitch machine and cover seam machine.

Phase 9: After the assembly process, three participants were asked to test and evaluate these samples. Feedback from the participants is discussed in the research findings.

The prototype is developed by adopting universal design principles and considering different body shapes. Categories were developed based on respondents with a big bust and smaller hips and plus-size females with a big bust, tiny waist and big thighs, for example. Data is valuable since it may practically and clearly demonstrate the differences between what is available on the market for plus-sizes and the expectations of plus-size females regarding fit satisfaction levels.

3.7. Ethical clearance and communication

The CPUT's ethical clearance for the executing of a research study was obtained. This was important as the participants had to share their perceptions and photographs to address the research problem. All participants signed consent forms after all the steps of the research were thoroughly explained.

3.8. Summary

This chapter explained the research design and methods for this study. The intention is to answer the research question and generate evidence that will assist in the design development process of a garment prototype. This study not only includes qualitative research, but includes practical research, data collection, sampling and tools to support the study.

CHAPTER 4: PRESENTATION OF DATA FINDINGS

4.1. Introduction

The purpose of this study was to address the needs of plus-size females by investigating through the online survey their perceptions and frustration about fit of active wear currently available in the market. Incorporate the practice-based study for the design develop of inclusive prototypes of leggings and tops and present improved active-wear design for plus-size females.

4.2. Presentation of online survey findings

4.2.1. Overall fit satisfaction with current active-wear offered by SA clothing retailers

Participants were asked to rate the overall fit satisfaction of the active-wear available in the market, from 1 poor (which means they are not satisfied with fit), 3 moderate (which means they are neutral) and 5 excellent (which means they are satisfied as explained in 4.2.1). Figure 4.2.1. is a bar chart presenting the responses from the participants, with 42.11% of plus-size which most presented as neutral because they mentioned that active-wear is available in the market; however, they often purchase items and ask local designers to make alterations for them.

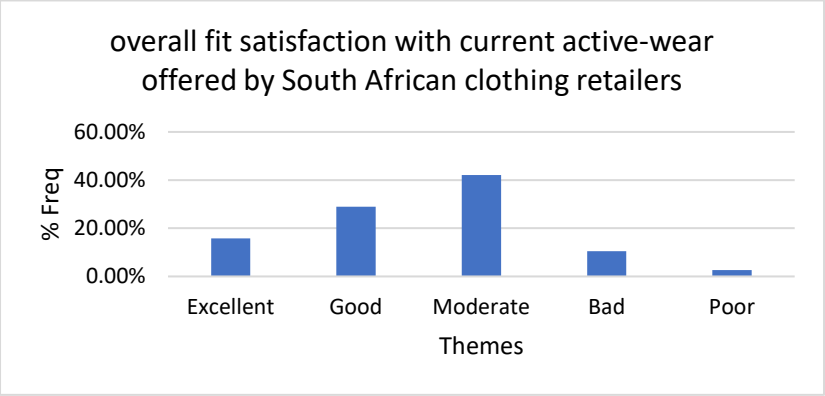

Figure 4.2. 1 Overall fit satisfaction with current active-wear offered by South African clothing retailers

4.2.2. Section A: Likert scale plus-size women shopping experience

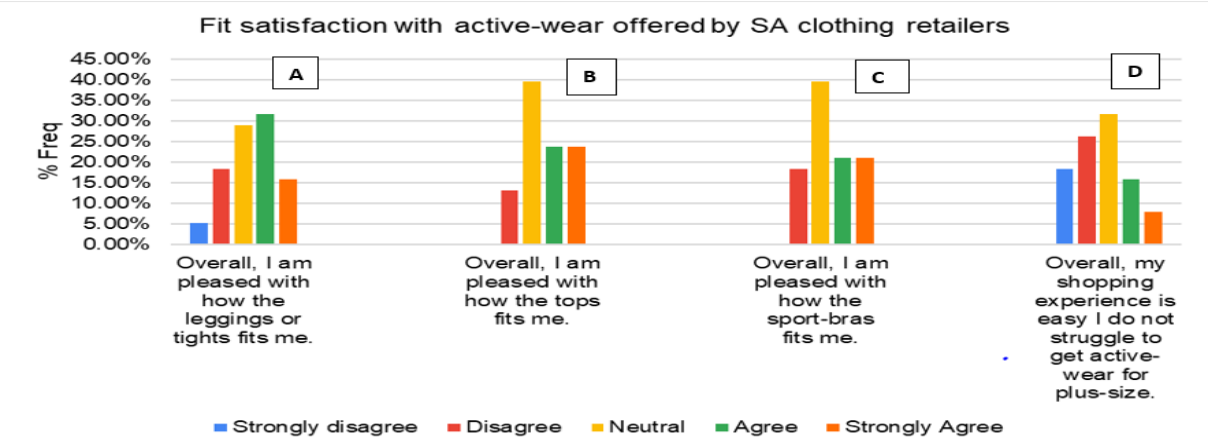

Figure 4.2. 2 Fit satisfaction with active-wear offered by SA clothing stores

As discussed in 4.2.1, plus-size females participants were given four statements to rate from 1 Strongly Disagree (which means they are not happy at all with what they purchase), 2 Disagree (means somewhat not happy), 3 Neutral (means neither happy nor unhappy), 4 Agree (means somewhat happy) and 5 Strongly Agree (which means they are very happy with these clothing items). Figure 4.2.2 presents graph A, B, C and D.

Graph A: 31.6% plus-size females are somewhat agree with what is available in the market; 28.9% were neither happy nor unhappy; 18.4% were somewhat not agree 15.8% were very happy; 5.3% of plus-size women were not happy at all.

Graph B: plus-size females were rating tops with 13.2% of plus-size women were somewhat unhappy with the tops they purchase; 39.5% were neither happy nor unhappy; 23.7% were somewhat happy; and 23.7% were very happy. As mentioned in 4.1 in the introduction, the researcher will be evaluating and analysing leggings only. Tops will be designed and sewed only for the presentation of the prototype.

Graph C: plus-size females rated sport bras with 18.4% somewhat not happy with the fit of sport bras; 39.5% neither happy nor unhappy; 21.1% somewhat happy; and 21.1% very happy with the fit of sport bra. Also, this clothing item is not going to be designed; but it will be discussed in future studies.

Graph D: the participants rated the overall shopping experience when plus-size females are shopping for active-wear. About one fifth (18.4%) of plus-size females were not very happy with the shopping experience; 26.3% were somewhat not happy; 31.6% were neither happy nor unhappy; 15.8% were somewhat happy; and 7.9% were very happy with shopping experience.

These findings draw conclusion by stating that graph A is presenting blue and red in the bar chat the negative view that leggings (tights) currently available does not fit properly and yellow bar presenting plus-size females that were neutral as they are in between which also represent the negative results supporting the study that indeed the need to re-look at the current fit and make improvements is essential. Graph B, yellow bar is presenting most plus-size women are neutral which also means neither happy nor unhappy with tops available and the red bar which is presenting plus-size women that are not happy. The fact that there is a percentage of women that are not happy is supporting this problem. Graph C, about 20% of plus-size females are not happy and 40% are not sure, and lastly graph D is presenting the overall shopping experience. The current active-wear were does not fit properly, there is a significant proportion of plus-size females who are not pleased with what is currently available.

4.3. Section B: Open-ended questions

4.3.1. Experiences of plus-size females with active-wear fit in general

This question sought the experiences of plus-size women with active-wear fit. The results in Figure 4.3.1 in the bar chart shows the responses concerning experiences. About 73% of plus-size women have expressed their feelings that it is a bad experience for them when come to the shopping of active-wear. This supported by the conclusions that are drawn from graph D, the overall shopping experiences in Figure 4.2.2 they struggle to

find what they like or what is suits their body shapes and current active-wear does not fit properly.

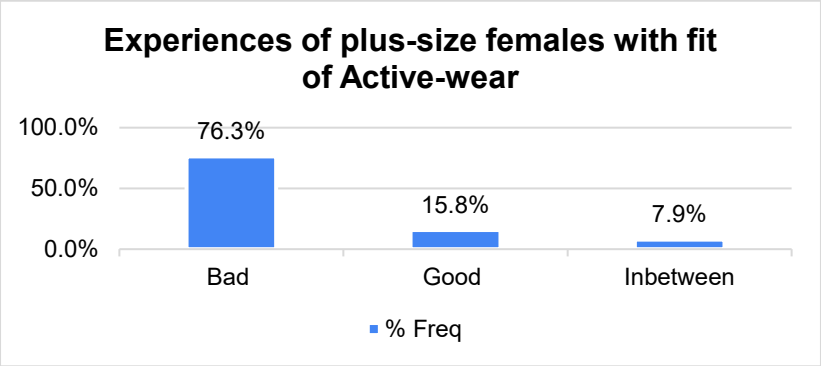

Figure 4.3. 1 Experiences of plus-size females with fit of active-wear

4.3.2. Reasons for bad experience

Based on the responses of plus-size females on the question that was asked about fit being good or bad, plus-size women stated reasons as to why they chose their answers. The results are shown in Figure 4.3.2 as to why the current active-wear does not fit properly. There for it has been discovered that the reason for this bad experience is poor sizing. Plus-size women has expresses other factors such as poor quality which also look at the performance of the active-gear, poor fabric, they are expensive, and choice is limited. About 78% are complaining about poor sizing, therefore the problem is the fit on these current active-wear.

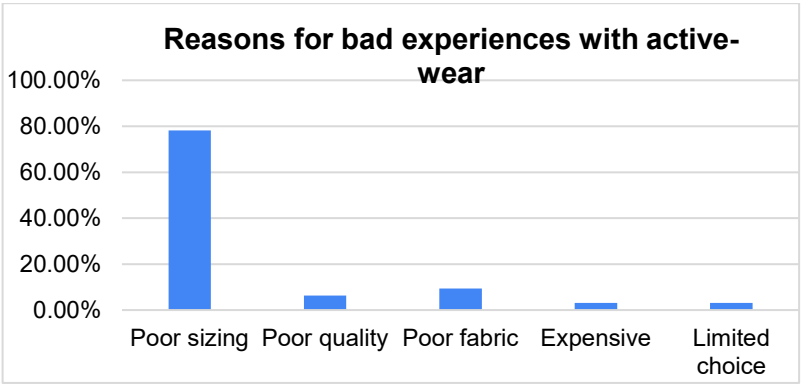

Figure 4.3. 2 Reasons for bad experiences with active-wear

4.3.3. Perceptions of plus-size women about active-wear fit.

Plus-size women willingly shared their personal views about fit satisfaction level of current active-wear. They expressed their challenges from which the researcher captured themes from their responses where they identified fit, comfort, garment performance, bodily area of garments where they find garments are restricting them from performing well during physical activities, fabric used and incorrect sizing. Figure 4.3.3 below shows the themes which emerged drawn based on the perceptions of participants.

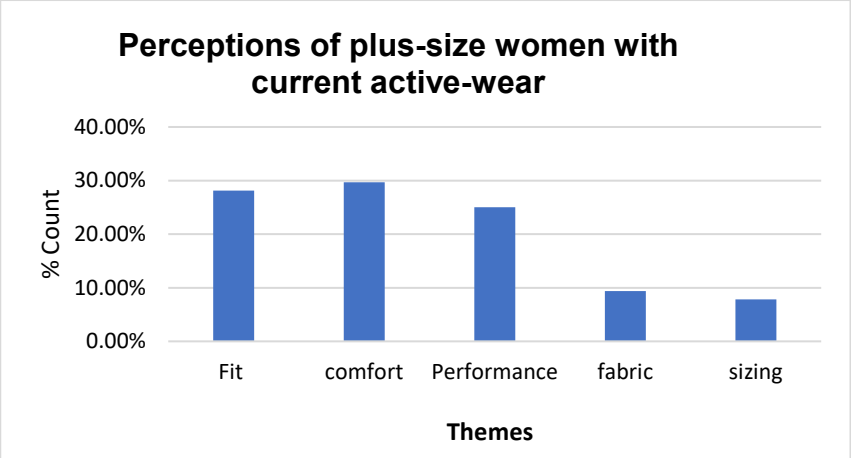

Figure 4.3. 3 Perceptions of plus-size women with current active-wear

4.3.4. Garment areas in which active-wear give fit challenges

Plus-size women face an array of challenges when shopping for active wear. Figure 4.3.4 below presents the garment areas which plus-size women find problematic. The researcher created guidelines for the participants from which to identify specific challenging areas with active-wear.

The guidelines were created by the researcher listing body dimensions to select problematic areas, waist identified by 30.36%; back and front crotch line identified by 23.21%; and the bicep identified by 8.9% as the area presenting the fewest challenges. This study is presenting the African women and the fact that their figure form is wide-hipped with prominent buttocks (Pandarum, 2015) these results is supporting this statement because with hip area identified as the most problematic by 37.50%.

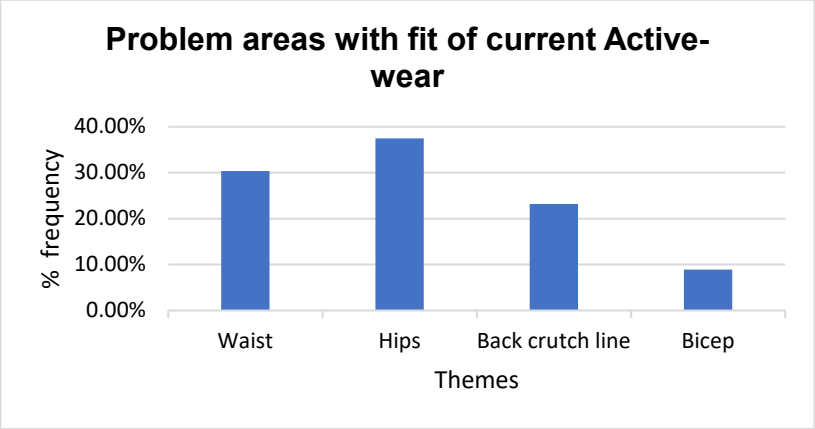

Figure 4.3. 4 Problems areas with fit of current active-wear

4.3.5. Body areas that experience most problems in terms of fit

Plus-size females identified problem areas in which they experience fit challenges with active-wear. Figure 4.3.5 below presents the garment areas identified from the survey. The most problematic area was bust 26.79%; followed by hip 21.43%; waist 16.07%; thighs 7.14%; arms 3.57%; and stomach 3.57%.

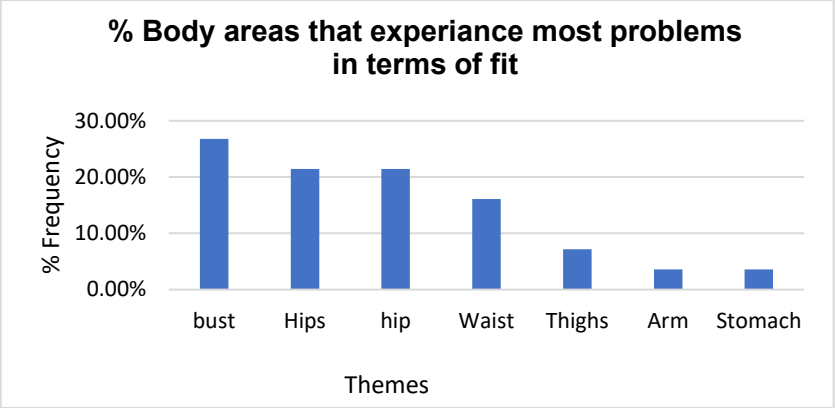

Figure 4.3. 5 Body areas that experience most problems with fit

4.3.6. Major concerns of plus-size females when purchasing active-wear

Figure 4.3.6 presents themes of the major concerns identified by plus-size women in the survey.

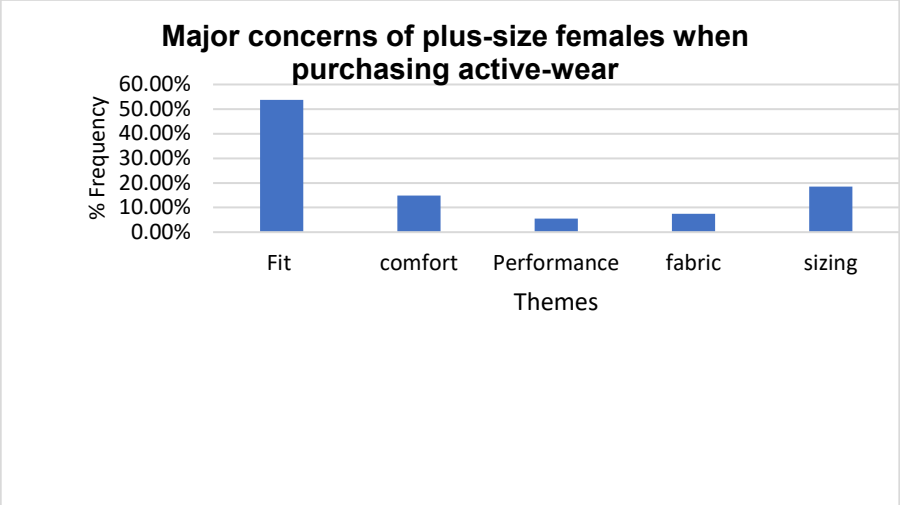

Figure 4.3. 6 Major concerns of plus-size females when purchasing active-wear

4.3.7. Suggestions to improve fit of active-wear for plus-size women

Figure 4.3.7 presents the suggestions made by plus-size women for improving active-wear in the future.

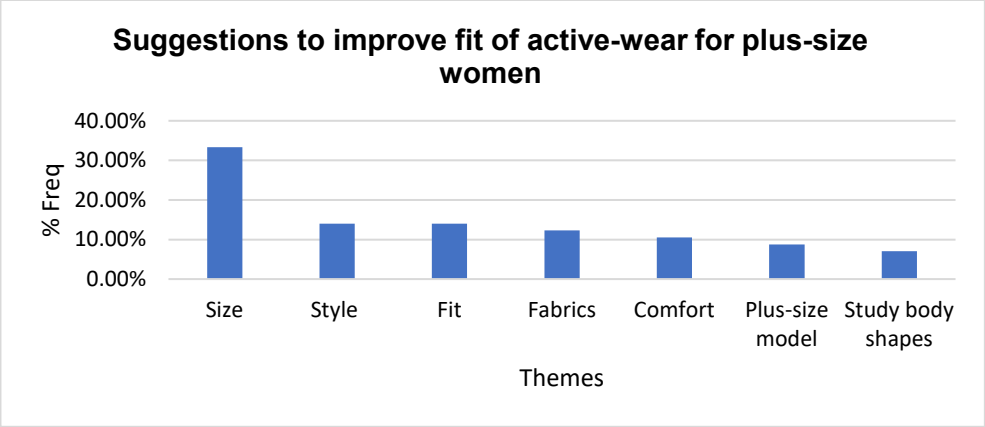

Figure 4.3. 7 Suggestions to improve fit of active-wear for plus-size women

The finding of this online survey has discovered that there is a problem with active-wear currently available. These findings from the survey were used as the solid foundation in the practice-based research. Before the design development of the prototypes, the research has drawn conclusions to improve the fit of active-wear to suit plus-size female body shapes. The bar charts presented finding where plus-size women identified their challenges and in summary to the following challenges were highlighted:

- Their major concern is fit of active-wear currently offered to them.
- Poor fit because of the poor sizing
- The most problematic areas are hips and bust, because it has been discovered that African women have wider hips and prominent buttocks.
- According to their perceptions fit and comfort were the most important in active-wear.
- In Figure 4.3.7, about 33% plus-size females suggested that South African sizing system needs improvements which this will improve the size of current active-wear. 14% suggested also that the style is very important, they want to wear aesthetically pleasing garments to boost their confidence.

4.4. Practice-led research: eight phases of iterative exploration

4.4.1. Phase 1: Active-wear garment comparison from Stores A, B and C

Phase 1 has two parts where part 1 was to observe and analyse the leggings in stores before inviting the participants to a fitting session. Part 2 involved inviting the selected two participants who wear size large (L) and double extra-large (XXL) to a fitting session of the active-wear currently available in the market to evaluate fit.

4.4.1.1. Part 1: Analysis of three pairs of the leggings when not worn by the participants

The researcher visited three different clothing stores in close proximity for easy access in one shopping mall in Cape Town. These stores were selected because they had a large selection of plus-size active-wear. Many people shop from these stores and their prices are reasonable and suited the researcher's purchasing budget for leggings. This was done to evaluate and familiarise herself with current active-wear across all sizes but specifically with reference to plus-size apparel. The aim was to observe and analyse these garments by looking at design features such as styling details of active-wear currently available, fabrics used and garment silhouettes.

For the sake of confidentiality and ethics, these stores are referred to as stores A, B and C. Three pairs of leggings were purchased from these three selected stores to investigate their styling detail, garment silhouettes and fabrics used and to test their fit on plus-size women. The three pairs of leggings were purchased, rather than bras or tops, to serve as a control in this study. Time and financial constraints did not allow for the design and development of additional items. The primary reason, however, is that plus-size females indicated exercise leggings as the most problematic pieces of active-wear apparel. Tops were subsequently designed for the purpose of the final prototype presentation.

4.4.1.2. Part 2: Analysis of three pairs of the leggings when worn by the participants

As mentioned in Chapter 2, there are no parameters that define sizing for plus-size women in South Africa. The sample sizes for the store-bought leggings are sizes large (L) and double extra-large (XXL). The researcher selected plus-size women who wear

size large and double extra-large as the sample size in the design development of the prototype. The participants were coded as Participant T1 and Participant Z2 (refer to Figure 4.4.1 below).

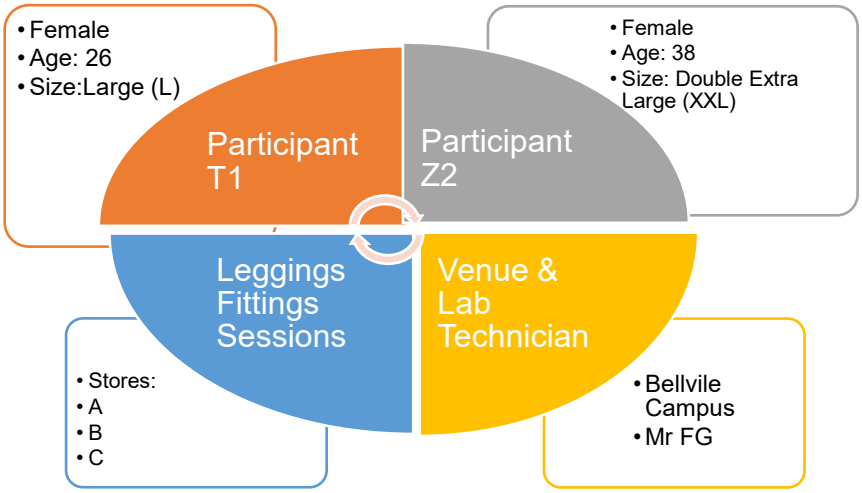

Figure 4.4. 1 Analysis of three pairs of leggings when worn by plus-size females

The participants were coded as Participant T1 and Participant Z2. Participant Z2 is a 38-year-old plus-size female who wears double extra-large size (XXL) and Participant T1 is a 26-year-old plus-size female who wears size large (L). Fitting sessions of the three pairs of leggings that were bought from Stores A, B and C were organised. Participant T1 and Participant Z2 were invited to the CPUT Clothing & Textile Technology Department at the Bellville campus on 25 August 2022. The researcher liaised with the lab technician, Mr FG, who is responsible for Garment Construction and Pattern Construction labs, to organise a venue for the fitting session. The organised venue was safe and private to ensure the participants were comfortable during the fitting and changing process. Mr FG, an expert in the technical aspect of clothing manufacturing, assisted in technical observations of the three pairs of leggings. This phase was necessary to verify the responses from the online survey, where plus-size women identified body areas that were most problematic in terms of fit. From the question that asked participants to identify problematic areas, 37.50% of plus-size women have a problem with hips; 30.36%

identified waist area; and 23.21% of plus-size women identified back and front crotch line, claiming that tights pull down during exercise to reveal their stomach and back waist.

4.4.1.3. Presentation of Part 2: Analysis of three pairs of the leggings when they are worn by the participants

Store A is one of the leading` retail stores selling hot fashion at a low-price, ranging from the hottest trends to wardrobe must-haves. Customers from all over Africa have been served by the store for its more than 30 years of operation in the clothing and textile sector. The store carries items for everyone in the family, including clothing for men and women, baby wear, school supplies, digital devices, pet accessories, home décor and active-wear. The leggings selected from Store A are made of 92% nylon and 8% elastane.

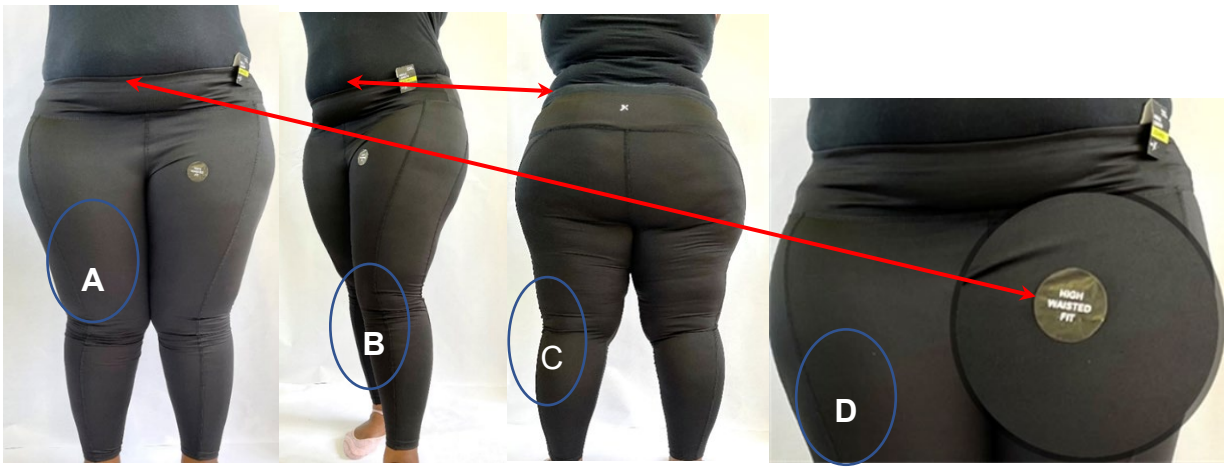

Figure 4.4. 2 Participant Z2 (XXL) fitting Store A leggings

Figure 4.4.2 presents Store A fit evaluation with Participant Z2 who wears XXL. The researcher took images in the fitting session to demonstrate how these leggings fit this plus-size female participant. As picture A shows, in a front view of the participant, these leggings are high waisted, as shown in in picture D. If we look at picture A however, these leggings are not fitting properly up to the natural waistline as its design is supposed to be a high waist. Picture B shows the side view and picture C shows the back view. An analysis of these four pictures verifies there is a problem with fit and waist. Tight fit around hips, legs and a low crotch line were identified as problematic areas in garment fit. The researcher continued to fit the same legging to Participant T1 to evaluate fit.

Figure 4.4. 3 Participant T1 (L) fitting Store A leggings

Participant T1 who wears size large (L) tried on Store A leggings that are an XXL as mentioned above. Participant T1 typically purchases size large (L) in other stores; however, from Store A, the XXL size fitted better with minor alterations on the waistline as compared to her original size of L. Refer to picture E which shows the front view of the legging. These leggings are designed to be high-waisted and a look at picture F shows a correct fit as stated on the sticker pointed out in Figure 4.4.2 D. When analysing picture F and G, even though the leggings were fitting, the back view shows the need to make a minor pattern alteration around the waistline to perfect the fit. The participant also mentioned that the leggings fit her tight around her legs. Lastly, Participant T1 discovered that she would rather purchase XXL leggings in this store because sizes large (L) and XL leggings fit too tightly around her thighs.

Store B is one of the largest clothing retailers, a one-stop shop offering a wide range of food and grocery products at competitive prices. The store is well positioned to serve the needs of customers across all socio-economic backgrounds. In the past few years, this store expanded its clothing range to include active-wear. They offer a wide range of active-wear from leggings, sport bras, tops and accessories for South African women and men. Fabric properties for Store B leggings are 89% polyester and 11% elastane.

Figure 4.4. 4 Participant Z2 (XXL) fitting Store B leggings

Figure 4.4.4 shows Participant Z2 fitting XXL leggings bought from Store B. Picture A shows the front view, picture B shows the back view and picture C shows the squat position to test the performance of these tights. The feedback in terms of comfort from Participant Z2 is that while these leggings fit her, they were fitting tightly around her waistline, they were not flattering her stomach, and during movements, the waist was pulling down which required the participant to hitch up the tights regularly as parts of her body were revealed (picture C). These tights were not comfortable and were rated as poor fit. Also, the printed fabric colour was faded, making the design of the print lighter due to too much stretch of the fabric.

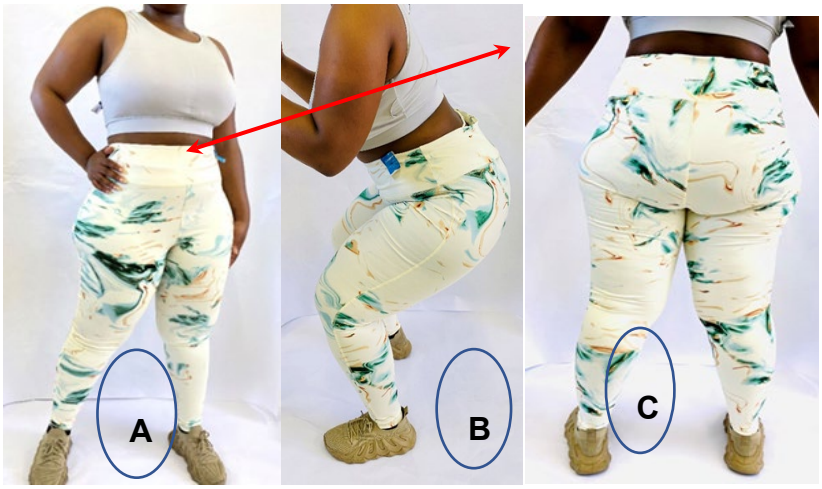

Figure 4.4. 5 Participant T1 (L) fitting Store B leggings

Participant T1 in Figure 4.5.5 wears a large size (L) when purchasing from other clothing stores such as Store C. These size XXL leggings from store B fit her better and she liked

both the style and the printed fabric. During this fitting process with Participant T1, the researcher observed the trend of Store A and Store B, where size XXL is designed quite small, which in this experience this size failed to fit a participant who wears size XXL but fit better on a person who wears size large (L).

Store C is a South African clothing retail store that has been operating for over 100 years. The store is popular for children's clothing as they are offer a wide range of clothing for children and women at low prices. Their target market is every woman with a child. The store has recently launched a sportswear range with different types of fabrics. The researcher purchased seamless legging to evaluate the fit and compare with the leggings purchased from Stores A and B. Figure 4.5.6 and Figure 4.5.7 present leggings purchased from Store C.

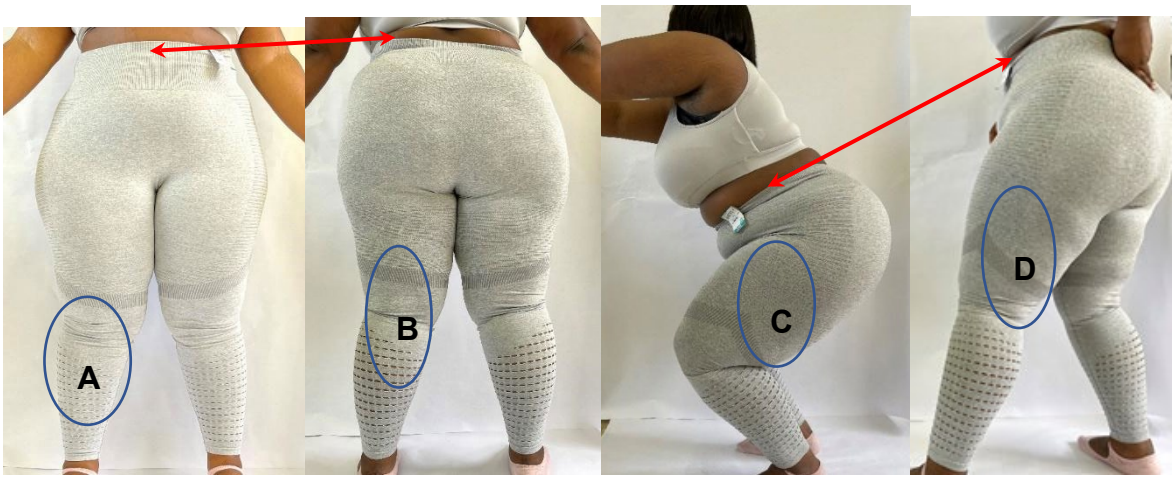

Figure 4.4. 6 Participant Z2 (XXL) fitting Store C leggings

Comparing this pair of legging with Store A and B, the leggings from Store C were the only garment that fitted Participant Z2 who wears size XXL. These leggings from Store C are seamless tights made in China using specialised power energy machines (Gao et al., 2021). The fabric properties of these tights are 58% nylon, 38% polyester and 4% elastane. Picture A shows the front view and picture B shows the back view. Participant Z2 was happy and comfortable with how these leggings fit her.

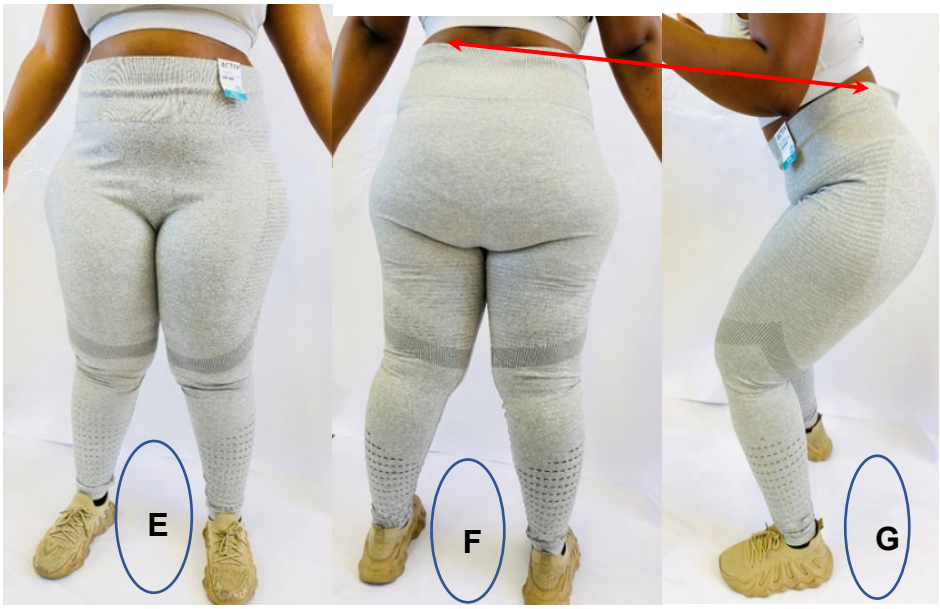

Figure 4.4. 7 Participant T1 (L) fitting Store C leggings

Figure 4.5.7 shows the fit of leggings from Store C by Participant T1. These seamless tights have more stretch than the tights from Stores A and B and as a result they are bigger, especially at the waistline.

4.4.2. Phase 2: Anthropometric data Figure 4.4.8, Figure 4.4.9 and Table 4.4.2.1 are presenting the body measurements of the participants that were involved in the process of the design development of the prototype.

Presentation of Phase 2: Anthropometric body scans

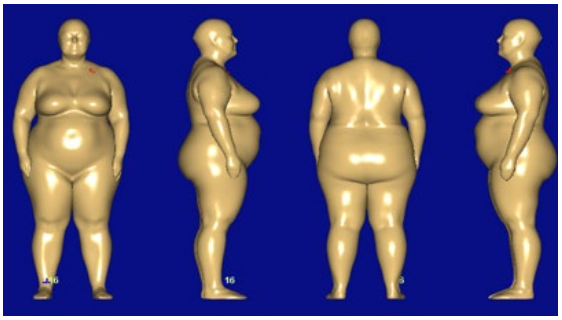

Figure 4.4. 8 Participant Z2 (size XXL)

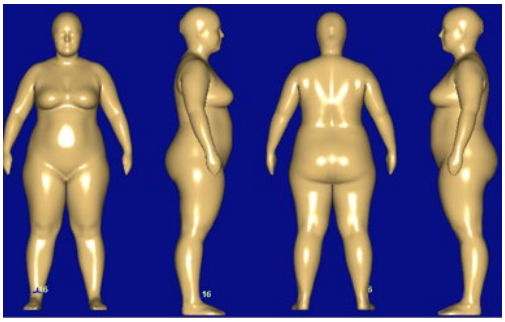

Figure 4.4. 9 Participant T1 (size L)

Table 4.4.2.1 1 Plus-size female participants body measurements, 3D anthropometric scan

Size	Participant T1(L)	Participant Z2 (XXL)
Bust	110.3	137.6
Waist	98.4	129.4
Hip	122	149

Table 4.4.2.1 presents the measurements taken from the 3D body scan. The researcher used these measurements to construct legging basic blocks size large (L) and double extra-large (XXL).

4.4.3. Phase 3: Construction of the leggings prototype basic block

As the researcher mentioned, this study is only analysing the leggings of plus-size women based on the feedback from the survey and from the garment comparison of the active-wear leggings that are currently available in Stores A, B and C. Then, further investigations were conducted by designing a prototype. To begin, the leggings basic block was constructed as the foundation to design the final leggings prototype. The prototype was based on the measurements from the anthropometric scan. During that process, the researcher considered the responses of plus-size females. Based on the data collected from the online survey the researcher examined the following results:

- Figure 4.3.1 indicates the overall fit satisfaction of plus-size females: 42.11% of these women were neutral, unsure whether they are satisfied or not with fit of plus-size active-wear.

- Figure 4.3.2 contains graphs A, B, C and D and also the responses: plus-size women were unsure whether they are happy or not happy with leggings, tops sport bras and because as plus-size women, they were neutral to this question.
- Graph A indicates that 28.9% of plus-size women were neutral with leggings; 31.6% were somewhat in agreement that leggings fit them; and 15.8% were very happy with the leggings. From these responses on the leggings, the researcher developed further interest in designing a prototype as plus-size females were doubtful about their responses.

- Figure 4.4.1, an open-ended section, shows that of the plus-size females, 76.3% of were not satisfied with active-wear currently available, saying the experience is bad.
- The researcher asked the participants to rate the experience of these garments, whether good or bad, and only 15.79% indicated that fit is good.
- Figure 4.4.2 indicates the reasons why they chose bad or good experience:
- 78.13% indicated poor sizing;
- 9.38% indicated poor fabric;
- 6.25% indicated poor quality;
- 3.13% indicated that active-wear is expensive; and
- 3.13% indicated that choices are limited.

From these explanation in Figure 4.4.2, the researcher asked the plus-size female participants to suggest their preferences, with their responses as following:

- 33.33% suggested that clothing manufacturers and retailers should improve the sizing system to clarify confusion of not knowing what size you wear as well as the fact that currently available active-wear is still not performing well.
- 14.04% suggested that fit of active-wear needs improvements.
- 14.04% suggested that the styling for plus-size active-wear range is not aesthetically pleasing and therefore needs improvement.
- 12.28% suggested that a need to assess the fabrics used to design active-wear.
- 10.53% suggested that clothing retailers and manufacturers should use plus-size models to test their fit.
- And 7.02% suggested a study of South African women's body shapes.

Supporting the responses, Bizunehe, et al. (2021: 339) states that "fit is the most significant deciding factor related to the final acceptance or rejection of a garment. Getting the right design is as important as getting a right product with a perfect fit." With this statement, the leggings basic block was constructed. The researcher invited Participant T1 and Participant Z2 to come to the first fit of the basic block.

During the first fit, the researcher evaluated the fit and focused on the problematic garment areas as indicated on the survey, namely waist, hips, back and front crotch line.

In focussing on these garment areas, and the researcher's observations during the fitting session of leggings from Stores A, B and C, these garment areas showed that plus-size females are unhappy with how they fit on their bodies, rendering the leggings uncomfortable.

Due to the challenges encountered in the process of developing prototypes, including delays in the arrival of the technical fabrics, it was decided that only legging prototypes would be constructed and evaluated. As stipulated in the literature, in South Africa the average women wear size 18 (Cooke, 2019). The researcher constructed leggings basic block size large (L) which corresponds with size 16 and double extra-large (XXL) which corresponds to size 18. To design and develop the leggings basic block, the researcher followed instructions from the *Metric Pattern Cutting for Women's Wear*, 6th edition (Aldrich, 2008).

The books that are used to teach patterns are *Metric Pattern Cutting for Women's Wear, 5th and 6th editions* (Aldrich, 2008). The difference with these editions is in the styling details and information about pattern construction, but the sizing charts are the same. In addition to this book, the researcher also had access to The *Fascinating Art of Creating Patterns* (Defty, 2007*)* which is replied upon by other designers. The researcher examined differences between these two books and discovered that the difference is the grading rule between the garment areas such as bust, waist and hips. In *The Fascinating Art of Creating Patterns*, the grading rule between the sizes is 4 centimetres and in the *Metric Pattern Cutting for Women's Wear* it is 6 centimetres.

According to the book, *Importance of grading rule in pattern making* (2007), each point of measurement is made larger or smaller according to the grading system so that it can fit a variety of sizes. The researcher selected *Metric Pattern Cutting for Women's Wear* because the grading measurements are larger than in the Defty (2007) book. That means the book selected to construct the basic blocks offers more ease or comfort than the other one, hence the researcher's choice of that particular book as a point of reference.

The leggings basic block was tested and refined, and the process repeated until a proper fit was achieved before the styling process began. Styling of the leggings was undertaken because 14.03% of plus-size women suggested that the need to assess and upgrade the

styling of active-wear currently offered to plus-size women. They expressed that the styling of active-wear is not aesthetically pleasing and not meeting their customer needs or preference, thereby limiting their choices as consumers. This is why the researcher designed a range to present the future ideas of active-wear using proposed fabrics that are mixed with bright and vibrant prints.

4.4.4. Phase 4: Presentation of the legging's basic blocks

In the process of constructing a basic block in patterns, the first step is to design a garment. This part requires the sewing of a mock-up, also called a sample. Figure 4.4.10 presents the first fit of Participant Z2 and Figure 4.4.11 Participant P1.

Figure 4.4. 10 First fit of the leggings prototype basic block size XXL

Figure 4.4.10 presents the fit of the legging basic block size XXL. The researcher observed the garment areas that needed alteration before styling the final product. As noted in Figure 4.4.10, A and B garment areas that needed alterations in this size were an increase in front waistline by 2 cm and the back-crotch line increased by 3.5 cm.

Figure 4.4.11 presents the second fit by Participant Z2. The alterations were done in the block around garment areas such as waist, front and back crotch line, and the length of the leggings. As shown in Figure 4.4.11. picture A, B and C show the differences of fit as

compared to Figure 4.4.10. The material used to sew these samples was nylon spandex and the colour was green. The researcher's use of this fabric was one of the challenges that delayed the completion of this research on time; the fabrics that were ordered by the researcher took a long time to arrive. Ultimately, the researcher found alternative material that was suitable for these prototypes and used it to test the basic blocks.

Figure 4.4. 11 Second fit of the leggings prototype basic block size XXL

Figure 4.4. 12 Leggings prototype basic block first fit, size large (L)

The alterations that were made in size large (L) leggings reduced the front waist and front crotch line by taking away 2.5 cm, as shown in picture A where there was fabric fullness around front area. Figure 4.4.13 presents the second fit of size large (L) with a better fit.

Figure 4.4. 13 Second fit of leggings prototype basic block size large (L)

Figures 4.4.12 and 4.4.13 present the first and second of the leggings basic block of size large (L). The final product presentation of fit of these blocks is shown in the styled pattern presented in the findings of this research in Chapter 5.

4.4.5. Phase 5: The styling of the final prototype range

The prototype design development process is an iterative process followed to create a working model of a product or system (Gerholz & Wagner, 2022). The process begins with a concept or idea, which is then refined into a preliminary design. This preliminary design is further refined and developed into a final design. The final design is then used to create a prototype, which is tested and evaluated. If the prototype is successful, it is then mass-produced. This process allows designers to explore multiple design solutions and rapidly test and refine them (Gerholz & Wagner, 2022). Based on what has been discussed in phase 4 after the construction of the leggings basic block, the researcher conducted first fit and second fit of the basic block with Participant T1 and Participant Z2. The first fit was to evaluate how the legging's fit so alterations could be made. The second fit was to evaluate the alterations that were made as a result of the first fit. After this phase, the researcher developed active-wear range for plus-size women. This phase was the last phase where the researcher had to invite the participants to again come and fit the final prototypes and give feedback, as discussed in the recommendations of Chapter 6.

4.4.6. Phase 6: Fabric selection for the styled pattern (final prototypes).

The researcher bought fabrics at a local active-wear supplier that specialises in sport materials. This fabric supplier was specifically chosen because it was easily accessible to the researcher and provides high quality textile fabrics in Cape Town. The researcher was seeking suitable materials with moisture management properties, breathability, and enough stretch to allow comfort to the wearer when exercising. The fabrics that were purchased were printed nylon spandex, plain black nylon spandex and power mesh. The researcher tested these materials in the CPUT Textile Testing laboratory, assisted by the textile laboratory technician. Fabrics for the prototype were tested for moisture management, breathability and stretch and recovery to make sure they meet the required standard

The textile testing was done to test fabric quality and the fabric performance. Table 4.4.6.1, Table 4.4.6.2, and Table 4.4.6.3 show the results of the fabric quality which was rated in the grey scale between 1 which means the fabric colour dyes are poor and they are bleeding or creating a stain on the multifibre strip. When the rating is 4/5 or 5 that means the shades on the multifibre strip passed and it indicates that the fabrics are not bleeding or creating any stain. Table 4.4.6. 4 presents the characterisation of the knitted fabric properties which was done to test the performance of the fabrics. All the tests on the fabrics indicated its standard of quality and performance. These textile tests were vital because it was done to test the suitability of the material in terms of comfort and performance. Lastly the results of good design development of the prototype with poor fabrics would not be a successful practice-based study, therefore the results proved the good quality of the fabrics and was suitable for active-wear.

Table 4.4.6. 1 Colour fastness to perspiration

Multi-fibre strip	F1- Printed nylon spandex	F2- Black nylon spandex	F3- Power mesh
Wool	4/5	4/5	4
Acrylic	5	4/5	4/5
Polyester	5	4/5	4/5
Nylon	5	4/5	2/3
Cotton	5	4/5	4/5
Acetate	5	4/5	4/5

Table 4.4.6. 2 Colour fastness to dry cleaning

Multi-fibre strip	F1- Printed nylon spandex	F2- Black nylon spandex	F3- Power mesh
Wool	4/5	4/5	4/5
Acrylic	4/5	4/5	4/5
Polyester	4/5	4/5	4/5
Nylon	4/5	4/5	4/5
Cotton	4/5	4/5	4/5
Acetate	4/5	4/5	4/5

Table 4.4.6. 3 Colour fastness to wash

Multi-fibre strip	F1- Printed nylon spandex	F2- Black nylon spandex	F3- Power mesh
Wool	4/5	4	4/5
Acrylic	4/5	4	4/5
Polyester	4/5	4	4/5
Nylon	4/5	4	4/5
Cotton	4/5	4	4/5
Acetate	4/5	4	4/5

Table 4.4.6. 4 Characterisation of the knitted fabric properties

	Properties	Fabric 1 (printed nylon spandex)	Fabric 2 (plain black nylon spandex)	Fabric 3 (power mesh)
1	Fibre composition	20% spandex, 80% nylon	22% spandex, 78% nylon	15% spandex, 75% nylon
2	Fabric mass	170 gms	170 gms	160 gms
3	Dimensional stability % in Wales direction	-1	-1	-1.25
4	Dimensional stability % courses direction	+ 0.75	+0.75	+0.5
5	Stretch & recovery mean	99%	68%	72%
6	Seam strength extension	464	343	313
7	Moisture management (in 3 minutes)	13 mm	7 mm	8 mm
8	Air permeability	90.8 $cm^3/cm^2/S$	116 $cm^3/cm^2/S$	248 $cm^3/cm^2/S$
9	Pilling test	4-5	4-5	4-5

4.4.7 Phase 7: Presentation of technical drawings of final products (prototype range)

The prototype range presented in Table 5.5.6 was drawn from the plus-size responses, where participants pointed out the inadequacy of stylish active-wear for plus-size women as well as reasons why they experience challenges with fit of active-wear. They desired a design of leggings that would enhance comfort while boosting their confidence. Technical drawings were constructed using the Kalido software and the researcher had access to use only this software hence it was chosen. The researcher incorporated universal design as products should be designed in such a way that they accommodate an individual's needs to the greatest extent possible (Park et al., 2014). Participants then fit the garments and gave feedback for the final products (see Appendix G).

Table 4.4.7 1 Universal design principles adopted to design inclusive prototypes (Park et al., 2014)

Equitable use	The use of South African women sizing. The design of prototype should accommodate everyone.
Flexibility in use	Fabrics selected are tested in the CPUT Textile Lab to check the quality and performance of the fabrics.
Perceptible information	Designs are stylish and comfortable to motivate and encourage participation in any physical activity.
Tolerance for error	Fabrics are tested for fabric performance, such as stretch and recovery, seam strength and others to ensure these garments meet the needs of plus-size.

Low physical effort	The design should be easy to find, easy to wear, comfortable and flexible and should not restrict the wearer in performance.
Size/space for use	Anthropometric data was collected to use the right measurements of plus-size women.
Intuitive use	Prototype testing was done from basic blocks to final products. The prototype is designed to meet the needs of plus-size women and feedback is required to improve the fit till it is right.

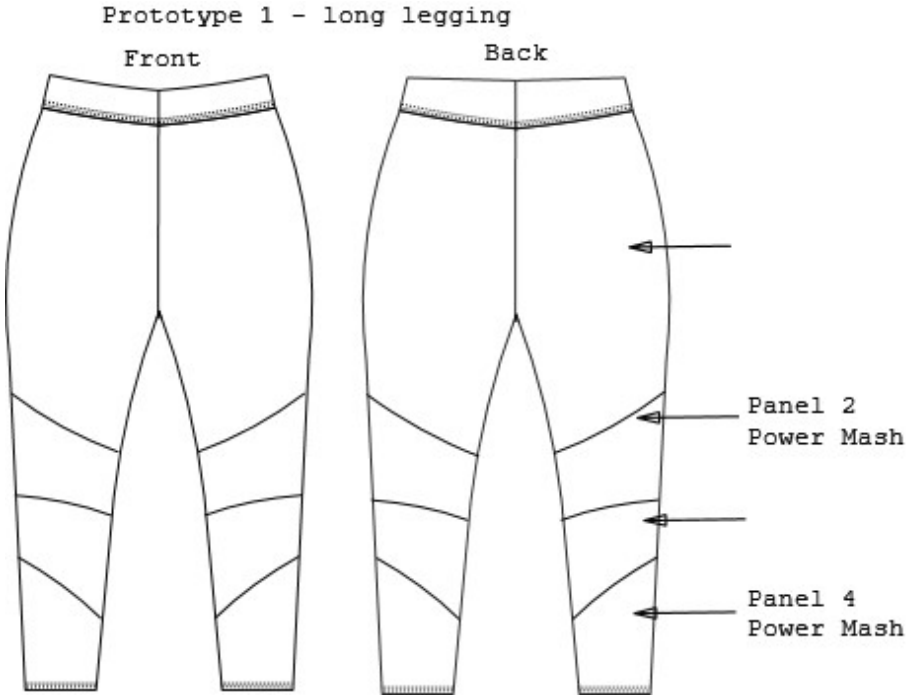

Figure 4.4. 14 Prototype 1 styled leggings for plus-size

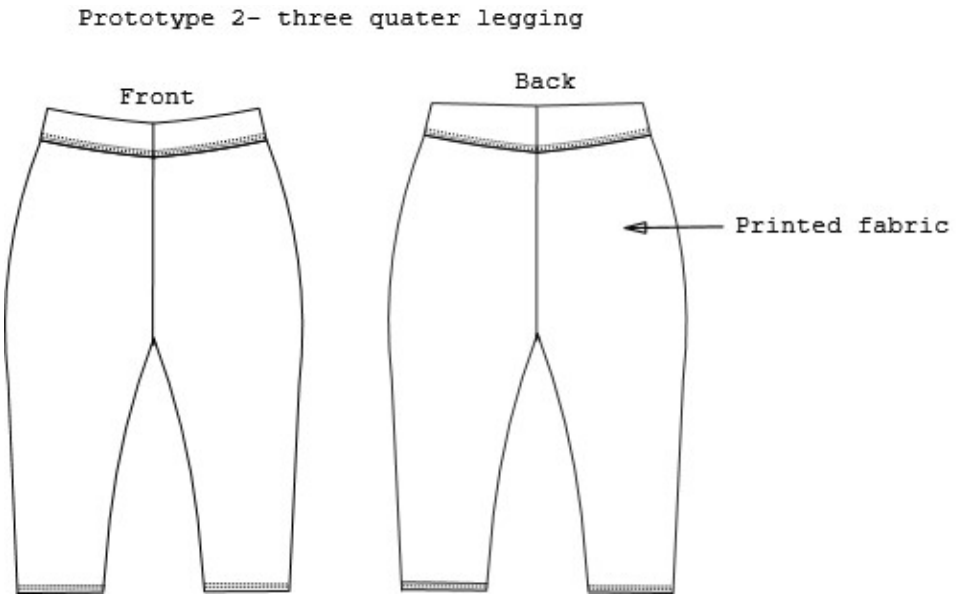

Figure 4.4. 15 Prototype 2 styled leggings for plus-size

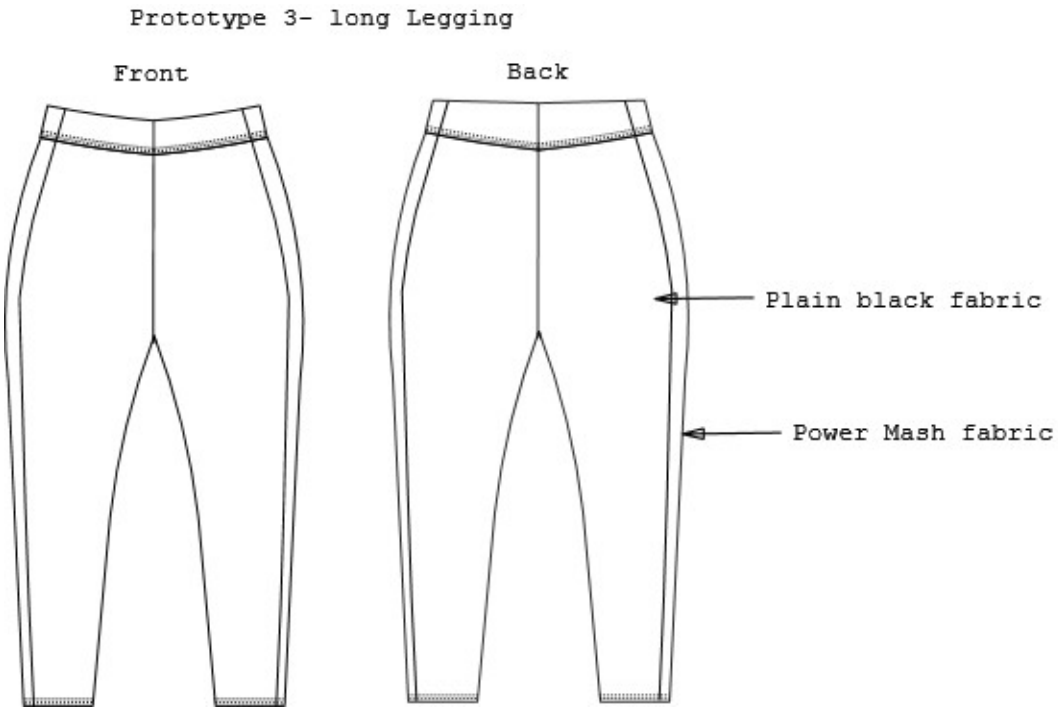

Figure 4.4. 16 Prototype 3 styled leggings for plus-size

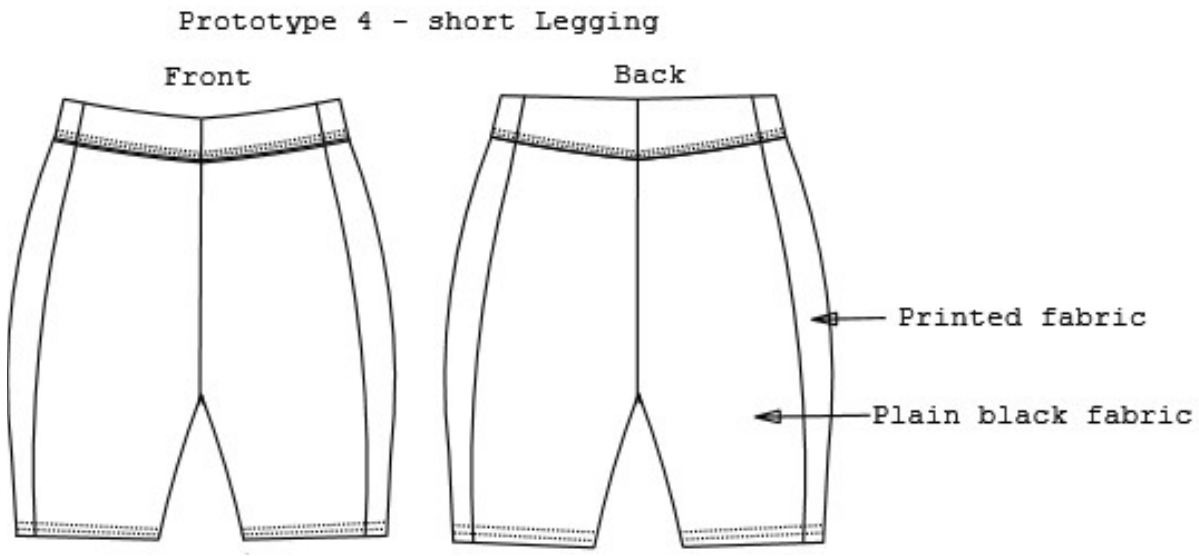

Figure 4.4. 17 Prototype 4 styled leggings for plus-size

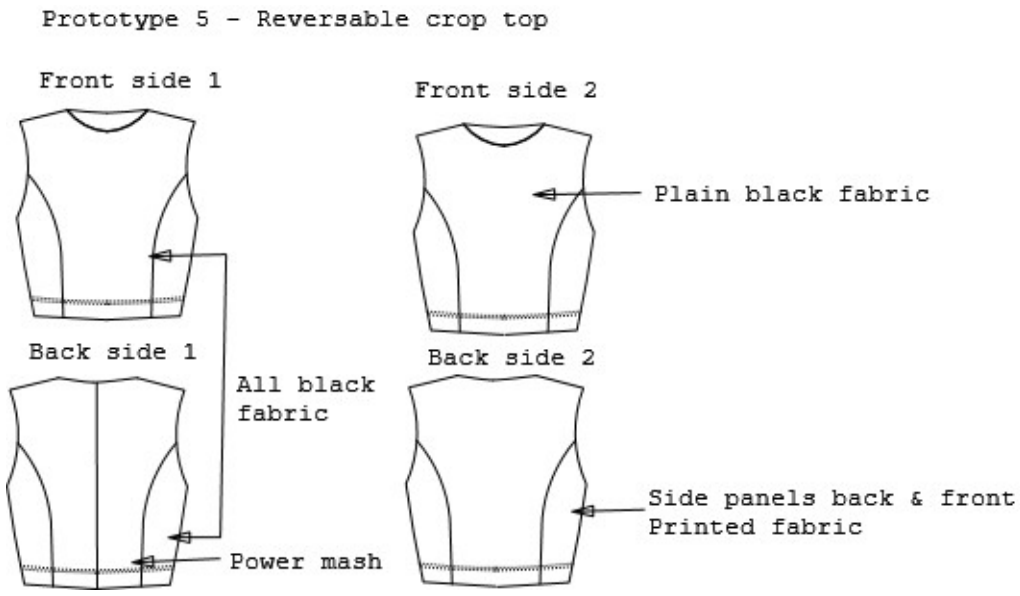

Figure 4.4. 18 Prototype 5 styled reversable crop top for plus-size

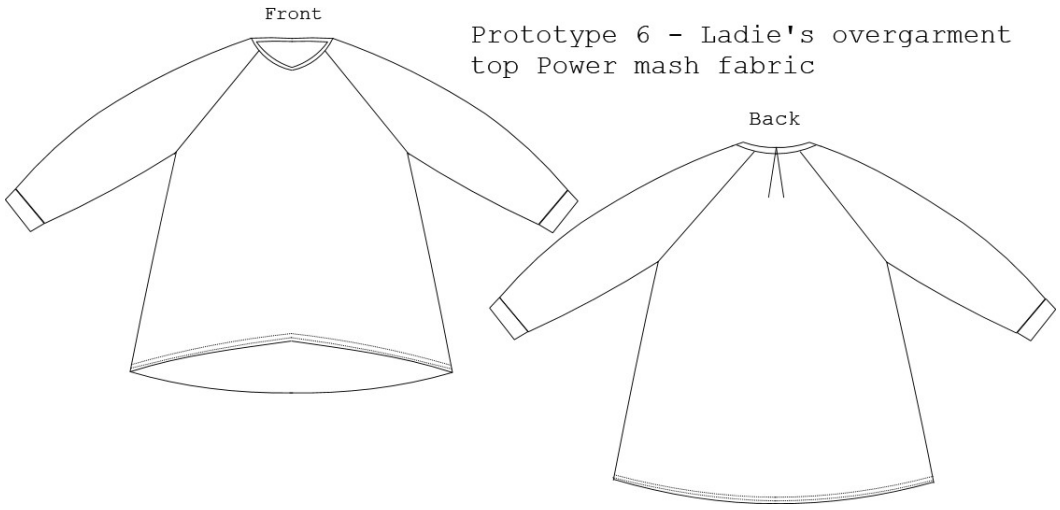

Figure 4.4. 19 Prototype 6 power mesh overgarment top for plus-size

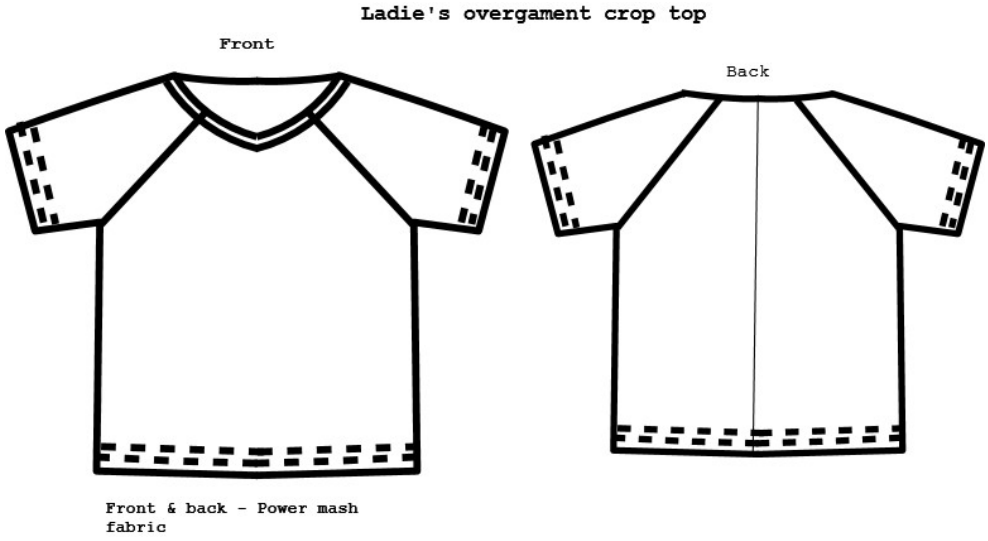

Figure 4.4. 20 Prototype 7 styled power mesh overgarment crop top for plus-size

4.4.8. Phase 8: Assembly process of the prototype

The construction process of active-wear is a highly specialised and skilled process that requires a great deal of knowledge and experience. This was the first attempt of the researcher to design and sew these types of garments. According to the research that was undertaken prior to the assembly process of the active-wear prototypes, the selection of appropriate fabrics is very important (Nigmatova et al., 2018). The fabric must be able to absorb sweat, be breathable, and be stretchy enough to allow for a full range of motion

(Mohammadi et al., 2022). To be effective, the right machines, seam types, stitches and threads should be used. The seams of active-wear apparel are typically reinforced to prevent them from coming undone during use. One of the textile laboratory tests conducted by the researcher was the seam strength test, with results discussed in the analysis of the findings. The production of this prototype range was done by the researcher at the CPUT, Bellville campus. No production work was outsourced. An overview of garment construction breakdown of the leggings is attached (see Appendix J). The three components of garment construction are preparation, assembly and finishing. Garment construction allowed the researcher to break the garment into manageable production operations in sequence and identify machines and equipment requirements.

Finally, the active-wear prototypes were inspected for quality not only for fabric testing but for seam types and stitches as this is a vital step that was done before testing the protoytype. The researcher was working in hand with the garment lab technician at CPUT Clothing & Textile, checking the quality of the garment as the researcher constructed the patterns and sewed the prototypes. The researcher invited the two participants who were involved at this stage (Participant T1 and Participant Z2) to come, fit and evaluate the prototypes and give feedback.

4.5. Summary

The research process was discussed in this chapter, using practice-led methods as an iterative progression to enable the researcher to explore the exact problem areas for plus-size women with the fit of current active-wear. Based on the data collected, this information helped the researcher to analyse and evaluate existing active-wear, including a garment comparison of currently available active-wear on the market (of three local retail stores), fabric selection for the prototypes constructed and textile testing in the laboratory, followed by the design development process of the prototypes to draw conclusions.

CHAPTER 5: DATA ANALYSIS AND INTERPRETATION OF FINDINGS

5.1. Introduction

Analysis of the data is presented in this chapter regarding plus-size women's experiences with active-wear already on the market, including their perceptions, purchasing behaviour, clothing alternatives, and fit satisfaction levels. Secondly, the causes are analysed of plus-size active-wear's inadequate sizing. Thirdly, an assessment of the fit satisfaction of plus-size female active-wear is carried out with an emphasis on the garment problem areas as identified by participants. This data was collected using two research methods: structured online surveys and practice-led research. The practice-led research comprised eight phases as described in detail in Chapter 4. The universal design theory was chosen and several principles were used in the creation of the prototypes developed to improve the fit of active-wear for plus-sizes women, as described in Chapters 2, 3 and 4. The focus of the researcher was to develop inclusive designs for an active-wear range, suitable to accommodate plus-size female bodies. The purpose of this chapter is to analyse the findings presented in Chapter 4, clarify its contribution to the clothing industry and foster body positivity of plus-size women to wear active-wear that makes them feel good.

5.2. Plus-size women’s experiences and level of fit satisfaction with active-wear

The researcher critically analysed the findings with the aim of developing active-wear prototypes. Participants were categorised into two groups. Group 1 represented plus-size, where 38 eight women participated in the survey. The second group represented two plus-size women size large (L) and double extra-large (XXL) whom the researcher involved in the practice-led research as models for the fitting sessions. Participants were coded to allow for the analysis of different figure types and sizes. This was necessary to test the hypothesis that there is inconsistency regarding sizing across clothing stores, and that this inconsistency is one of the factors that affects the fit women’s plus-size active-wear.

5.2.1. Analysis of the survey

Online surveys have revealed that women tend to have negative experiences with finding active-wear that fits well and comfortably on their bodies (see Figure 4.4.1 and Figure 4.4.2 for graphs and tabulated responses). Participant A expressed her experiences this way:

> *Mostly bad I likely to get something fitting me but then it reveals my back if it's a leggings. For tops you find it's a right size but due to my big arms and boobs, it gets too tight there and become so uncomfortable [sic].*

To summarise the survey, plus-size women firstly rated the overall fit satisfaction of active-wear. The questions were based on plus-size females' rating all the clothing items worn when performing any type of physical exercise. The garment items included tops, leggings and sport bras. The overall finding (see Figure 4.3.1) was that 42.11% of plus-size females rated the overall fit as moderate, indicating that these women were neither satisfied nor dissatisfied. To support these results further, the following statements were quoted from the survey:

> Participant S: *I'd buy it and do alteration so that it can fit me.*
>
> Participant A: *Sport-bra not fitting me and tops.*
>
> Participant H: *Not really have concerns most active wear fit me.*
>
> Participant S: *Leggings are always see-through or the material is not the right material, shows your cellulite. The pants become transparent the more you stretch them by bending over.*

Most of these plus-size participants rated fit satisfaction as poor, because what is available on the market does not meet their needs and preferences as consumers. It was also revealed that plus-size women consider fit of active-wear important to their well-being. Therefore, plus-size women need active-wear that will not only allow them to move freely during the exercises but also active-wear that will boost their confidence (Evans, 2020). This sentiment was expressed by Participant S:

> *It breaks down my confidence when I am not feeling good in my active-wear. It's hard enough trying to find the right clothes to fit your body and, now you need to build courage to go to gym thinking that no-one is looking at you. A bad fit for me is when the pants are not all the way to the ankles*

and some part of my curves are sticking out. It's some sort of a latex material that is just too tight and showing every cellulite part of your body. Some of the pants have a see-through mesh in that I hate. The tops is not long enough to compliment the tight. Under that arms it is too widely cut so part of your bra is sticking out.

This survey revealed that fit is affected by many factors, as presented in Table 4.4.2 in Chapter 4. Those factors include poor sizing, poor quality of fabric and poor-quality construction of the garment. The following quotes support these findings:

Participant I: *Leggings ripped while I was working out.*

Participant E: *Leggings tore when I was fitting them for exercise.*

As fit is affected by poor fabric quality, it is necessary to analyse these fabric factors. This survey has demonstrated that the active-wear currently available on the market is inadequate regarding the needs and requirements of plus-size women.

5.2.2. Analysis of active-wear garment comparison of store A, B and C

While conducting active-wear garment comparisons, I observed how the pairs of leggings from Stores A, B and C ill-fitted the participants. During the fitting, the products of Stores A and B used fabrics that were tight and less stretchy, which made participants pull harder when dressing (refer to Figure 4.5.8, Figure 4.5.9 and Figure 4.5.10). The fit of leggings from Stores A and B was poor as noted by Participant Z2:

Good fit should keep me comfortable and relaxed. I always opt for bigger sizes to get the comfort I desire though it's very rare and frustrating to get bigger sizes.

Too tight and uncomfortable.

Having leggings or always rolls down when doing workout. And you have to constantly pull it up.

Participant Z2 concluded that,

Active wear should be comfortable, you should be able to move without discomfort. Having to work out as plus is difficult on its own, it’s even worse if you’ll constantly need to pull your leggings up or sport bottoms.

5.3. Analysis and interpretation of the plus-size anthropometric scan

Table 5.3.1 shows the differences between the body measurements of the sizing chart from the book *Matric Pattern cutting for Women's Wear* (Aldrich, 2008) and the measurements taken using the anthropometric scan. Each clothing store has its own sizing standard adopted from Western sizing standards (Pandarum, 2015). This evidence of poor sizing partly affects the fit of active-wear offered to plus-size females. The response of plus-size women about their experiences with exercise apparel (see Figure 4.4.1) shows that 76.32% of plus-size women identify fit as bad, which is a high percentage. The reasons for rating fit of active-wear (see Table 4.4.2) indicates poor sizing as the most significant contributor at 78.13%. Therefore, as evident in Table 5.3.1, results acknowledge the prevalence of problems with sizing and the effect of sizing on fit.

Table 5.3. 1 Plus-size female body measurements used in the construction process of the prototype leggings

Size	**(Aldrich, 2008)**	**Anthropometric scan**	**Measurement Differences**	**Interpretation**
	14-16 (L)	**PT1- (L)**		Overall, fit of active-wear currently available is affected by inaccurate sizing.
Bust	94 cm	110.3 cm	**16.3 cm**	
waist	74 cm	98.4 cm	**24.4 cm**	
Hip	100 cm	122 cm	**22 cm**	
Body rise	30.1 cm	33.6 cm	**3.5 cm**	
	XXL 26	**PZ2 – (XXL)**		Back crotch line was increased by 3.5 cm to fit on the natural waistline.
Bust	122 cm	137.6 cm	**15.6 cm**	
Waist	106 cm	129.4 cm	**23.4 cm**	
Hip	127 cm	149 cm	**22 cm**	
Body rise	33.8 cm	37,3 cm	**3.5 cm**	

The lack of a distinctively South African method for sizing clothing, the absence of cultural apparel at retail establishments, and the idea of a global village with free trade and imports of clothing from all over the world are all contributing to the factors affecting fit of plus-size active-wear (Pandarum, 2015). As retailers and clothing manufacturers continue to design primarily for the hourglass figure type utilising anthropometric data collected in the 1940s, these trends will continue to present a significant problem for the local and worldwide garment production businesses (Simmons et al., 2004; Pandarum, 2015). Based on the body measurements obtained from the anthropometric scan compared to the standard sizing chart from the *Metric Pattern Cutting for Women's Wear* (Aldrich,

2008), it is evident that the present clothing sizing systems used by manufacturers and retailers were adapted from the British, European and American systems to the exclusion of African women. Therefore, there is a need to relook at the sizing systems used for South African women's clothing as this is one of the major factors affecting fit, especially for plus-size women.

5.4. Background to design development of active-wear prototype for plus-size females

An active-wear prototype was designed with the needs of the plus-size in mind. The design development process began with analysis of the plus-size female responses on the qualitative survey and a garment comparison study of active-wear currently available. Based on the needs identified by plus-size women, the prototype was developed to meet the needs of plus-size females by adopting universal design principles to produce inclusive designs for functionality and style. Fabrics were selected to best suit the prototype range designed by the researcher. The leggings basic block prototype was then put through fitting tests with participants to ensure that it met necessary performance standards. Finally, the final product prototype range was designed and presented.

5.4.1. Analysis and interpretation of fabric tests

According to the findings of the CPUT Textile Laboratory testing, fabrics used to design the prototypes are suitable for active-wear. The researcher used three types of fabrics namely: power mesh, printed nylon spandex and black nylon spandex. Textile laboratory results are presented in Chapter 4 (see Table 4.5.6.1, Table 4.5.6.2, Table 4.5.6.3 and Table 4.5.6.4). The average fabric mass for nylon spandex is 170 gsm and for power mesh is 160 gms which means the fabrics are medium weight and suitable for use in active-wear. The fibre composition has Spandex for elasticity and Nylon for strength and comfort. The main concern of the researcher was to test air permeability as the fabrics are made of synthetic fibres. The stretch recovery of the nylon spandex fabric is 100%, which means the fabric stretches up to its end limit and still recovers. However, based on these results, if designers consider using these types of fabrics, pattern sizes should be adjusted to accommodate a proper fit. Bhattacharya and Ajmeri (2014: page) define *air*

permeability as “the volume of air in millilitres which is passed in one second through 100 mm2 of the fabric at a pressure difference of 10 mm head of water”. How well a cloth enables air to move through it is determined by its air permeability. Based on the results, the fabrics are breathable, with an air permeability of 90-248cm3/cm2/s on average. Hence, breathable fabrics are beneficial for regulating the body's temperature.

The main aim of moisture management fabric is to make the skin feel dry. Active-wear fabrics should evaporate and transfer moisture out of the body as soon as possible for comfort; this is known as wicking (Chinta & Gujar, 2013). Based on this explanation, moisture management was tested: the average in 3 minutes for printed nylon spandex is 13 mm, black nylon spandex is 7 mm and power mesh is 8 mm. That means these fabrics have wicking properties: they absorb moisture and dry it out of the body during a workout.

5.4.2. Construction processes of legging basic blocks and mock-up testing

The researcher developed prototypes to address the needs and preferences of plus-size women to ensure improved fit of future active-wear. The needs and requirements of plus-size women were drawn from responses to the online survey, and the analysis of three pairs of leggings bought by the researcher in local clothing retailers referred to as Stores A, B and C. Based on the findings of the online survey and from the active-wear garment comparison study, Chapter 4 presented the design development of the leggings basic blocks sizes L and XXL. To begin with, the patterns were constructed using body measurements of Participant T1 and Participant Z2 that were derived from the anthropometric body scan. The first fitting conducted (refer to Figure 4.5.10) of the XXL leggings was tried on by Participant Z2. Pattern alterations and adjustments were made and presented in Figure 4.5.11. Figures 4.5.12 and 4.5.13 presented the first and the second fit of Participant T1 who wears size large (L). During the alterations of these leggings basic blocks, the researcher applied the universal design principles of equitable use, flexibility in use, perceptible information, tolerance for error, low physical effort, size/space for use and intuitive use (Park et al., 2014). Table 4.5.7 presents these seven design principles that were applied in the design and assembly process of active-wear for plus-size women.

To construct the basic block pattern, measurements such as hips, body rise, waist-to-floor and high ankle were used, following instructions from the book *Metric Pattern Cutting for Women's Wear* (Aldrich, 2008). Body measurements such as body rise (33.8 cm) from size 26 are according to the book. The researcher used these standard measurements taken from sizing charts of medium height women of 160 cm to 172 cm.

For pattern adjustments and alterations (leggings basic blocks) that were made from size large (L), the researcher reduced the waist from front crotch line by 2.5 cm, and for size XXL 3 cm was reduced from the waist measurements. The front crotch line was increased by 2 cm and back crotch line by 3.5 cm.

5.4.3. Active-wear assembly process

The researcher constructed the patterns of four leggings and matching tops manually. Tops were only designed and sewn for the purpose of presenting a complete set of active-wear apparel, but only the leggings were analysed. To sew the final prototypes, a mock safety four thread machine was used. A cover seam machine was used to edge finish the hem of the leggings and to edge finish the elasticated waist. A cover seam is to produce a professional hem on stretchy fabrics. A lock stitch machine was used to stay-stitch elastic to the waist facing of the leggings before it was sewn in the cover seam machine. A 3.5 cm elastic was used to prevent the waist of the leggings from rolling down as this was one of the problems identified in the survey responses. In addition, the researcher observed the garment design of the leggings from Stores A and B which was problematic because materials were skimpy. Both pairs of leggings had a shaped waistband that was cut out of the same fabric used, with no elastic for reinforcement. Plus-size females expressed their major concerns about fit:

> *Having leggings or always rolls down when doing workout and you have to constantly pull it up. (*Participant A)

This resulted in the researcher improving the finishing of the waist by adding an elasticated waist.

Participant U also complained about the discomfort caused by a lack of waist finishing.

Active wear should be comfortable; you should be able to move without discomfort. Having to work out as a plus is difficult on its own, it's even worse if you'll constantly need to pull your leggings up or sport bottoms.

5.5. Analysis of final prototypes; active-wear leggings

Inclusive active-wear final products were designed to be flexible garments allowing the wearer to be comfortable when performing any physical activity. The researcher adopted universal design principles as discussed in Table 4.5.7. Figure 5.5.1 presents the prototype range: the researcher designed four leggings, two large (L) sizes and two double extra-large (XXL) with matching tops. The researcher organised a photoshoot and invited Participant T1 and Participant Z2 to come and fit the final products and take photographs. As mentioned in Chapter 4, a WhatsApp group was used as a platform to communicate with the participants. Participant L3, who wears size L, volunteered to come and assist in the fitting of the final products as the researcher's requirement was to also ask the participants to perform some physical activities or movements to test the fit. Participant L3 was a backup for Participant T1 since the testing required physical work. This was the final testing stage of the prototypes, and the participants gave feedback and recommendations to further improve the prototype for future studies.

Figure 5.5. 1 Presentation of prototype range worn by PZ2, PL3 & PT1

Figure 5.5.1 presents the inclusive design prototype range that was developed and designed by the researcher with the aim of addressing the needs of plus-size women. Participant Z2, Participant L3 and Participant T1 are looking to be active and they are feeling great about themselves as they were invited by the researcher to evaluate these garments. The positive comments received from these participants during the fitting session concerned the fabrics selected, and the vibrant and motivating style of this range to boost confidence. The researcher asked the participants to perform some physical movements to test the fit of these garments. The researcher organised gym equipment at the CPUT sports ground to create the exciting environment for the participants while testing and assessing the fit of the prototype range.

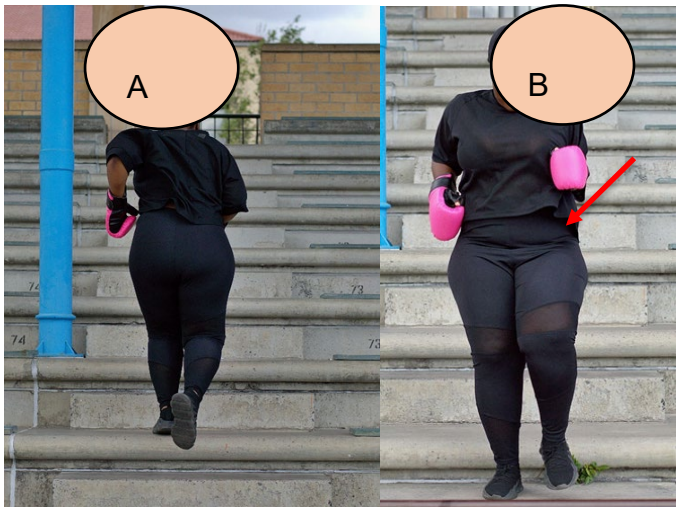

Figure 5.5. 2 Prototype 1 leggings worn by PT1, size L

Participant T1 was asked to test the leggings (prototype 1) by running up and down while moving her arms up and down to test the fit of the elasticated waistband. Picture A demonstrates the back view that was captured; it is notable that the participant was not bothered to pull the tights up while running as the waist stayed intact and the participant was comfortable and approved the fit as comfortable and flexible. These leggings allowed the participant to perform her activity freely and overall, Participant T1 rated the leggings '4' as she said the fit in front needed pattern adjustment as shown in picture B. My observations as the designer is that the cause of that excess fabric shows in picture B is due to too much stretch. The researcher adjusted the pattern accordingly by removing 1 cm from the back and the front crotch line and conducting a second fit to reassess the fit.

Figure 5.5. 3 Prototype 1 leggings worn by PL3, size L

Participant L3 fitted prototype 1 as well. Figure 5.5.3 shows picture A, a side view and picture B, the back view of the leggings. The researcher discovered that even though PT1 and PL3 wear the same size, and are both pear-shaped, there is a difference between their body features which resulted in the prototype fitting differently Participant PL3 has a larger buttocks than Participant T1 so the size large (L) legging samples fitted much better on PL3 (refer to Figure 5.5.2). The size large (L) leggings fitted better in terms of tightness, hugging the body perfectly (refer to Figure 5.5.2 PT1) compared to the fit in Figure 5.5.3 with PL3. As participant L3 has a larger buttock than Participant T1, before doing any alterations from the first fit of the final prototype, plus-size women need to be grouped together within each size to analyse their body shapes, conducting several fittings to determine what adjustments are needed to improve the pattern to best accommodate all potential body shapes.

Seen from this perspective, a careful study of South African women's body shapes was recommended by the participants in the comments and recommendation section in the survey for plus-size women (see Appendix F).

The need for researchers to further this study of South African women's body shape is supported by the literature. Pandurum (2015) explains factors that affect fit when adopting standardised garment sizing, suggesting that the following be considered;

- key body dimensions;
- study of figure types;
- description of correct garment size; and
- garment types grouped together.

Stamper et al. (2005) include other factors, insisting that fabric imperfections and body posture may result in purchasing incorrectly sized garments and may contribute to either well-fitting or ill-fitting garment choices. South African women's body shapes among the Nguni, Sotho, Tsonga and Venda tribes represent the ideal figure form as wide-hipped with prominent buttocks (Pandarum, 2015). Currently, Western female figures form the more recognisable images worldwide, as thin fashion models are iconised as the ideal figure form. Hence, there is a significant gap in the study of South African women's body shapes and sizes, particularly plus-sizes (Stamper et al., 2005; Pandarum, 2015).

Figure 5.5. 4 Prototype 2 leggings worn by PL3 size L perfoming physical movement, lunges

Figure 5.5. 5 Prototype 2 leggings worn by PL3, size L, bending and spreading arm movements

To analyse prototype 2 leggings, firstly the material is flexible enough that the print of the fabric does not fade as compared to the print of the fabric from Store B in the garment comparison. As mentioned by the researcher, the stretch and recovery test results of this fabric are 100%, meaning the material keeps its original look even if it worn by the plus-size women. The size is correct, the leggings are fitting properly, and there is no strain evident in the fabric either. The elasticated waistband allows the wearer to bend and move freely without restrictions.

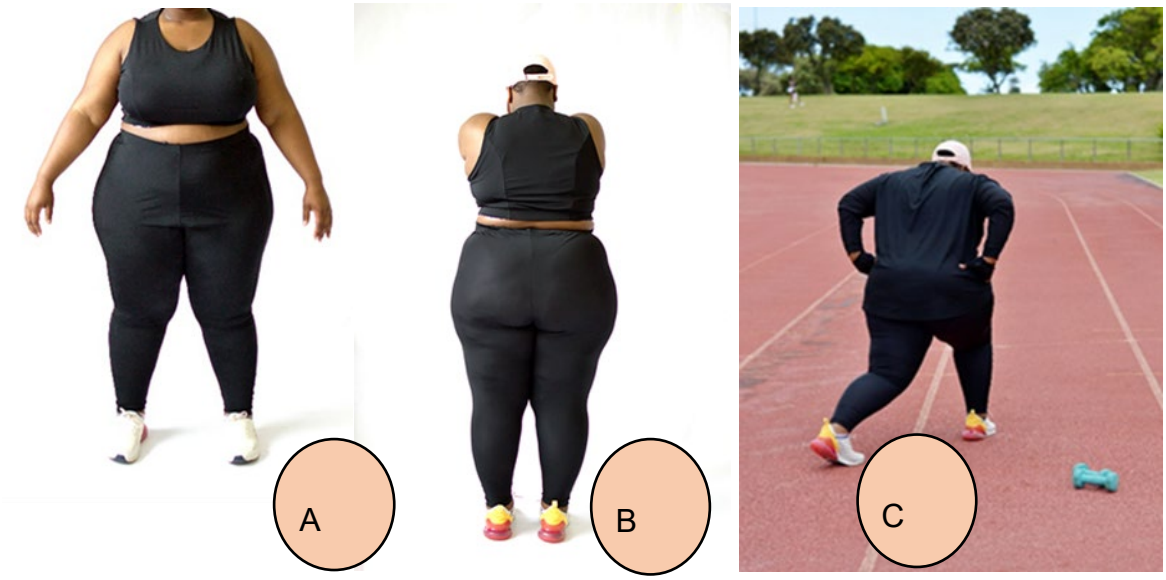

Figure 5.5. 6 Prototype 3 leggings worn by PZ2, size XXL

Figure 5.5.6 presents Participant Z2, who wears size XXL, fitting prototype 2 leggings. The leggings were rated ‘4’ which means the participant is happy but not exceedingly happy because there was too much stretch in the fabric, but the second fit of the XXL leggings basic block fitted perfectly (refer to Figure 4.5.11). Pattern adjustments and second fit are needed to refine the fit to suit this fabric and the participant.

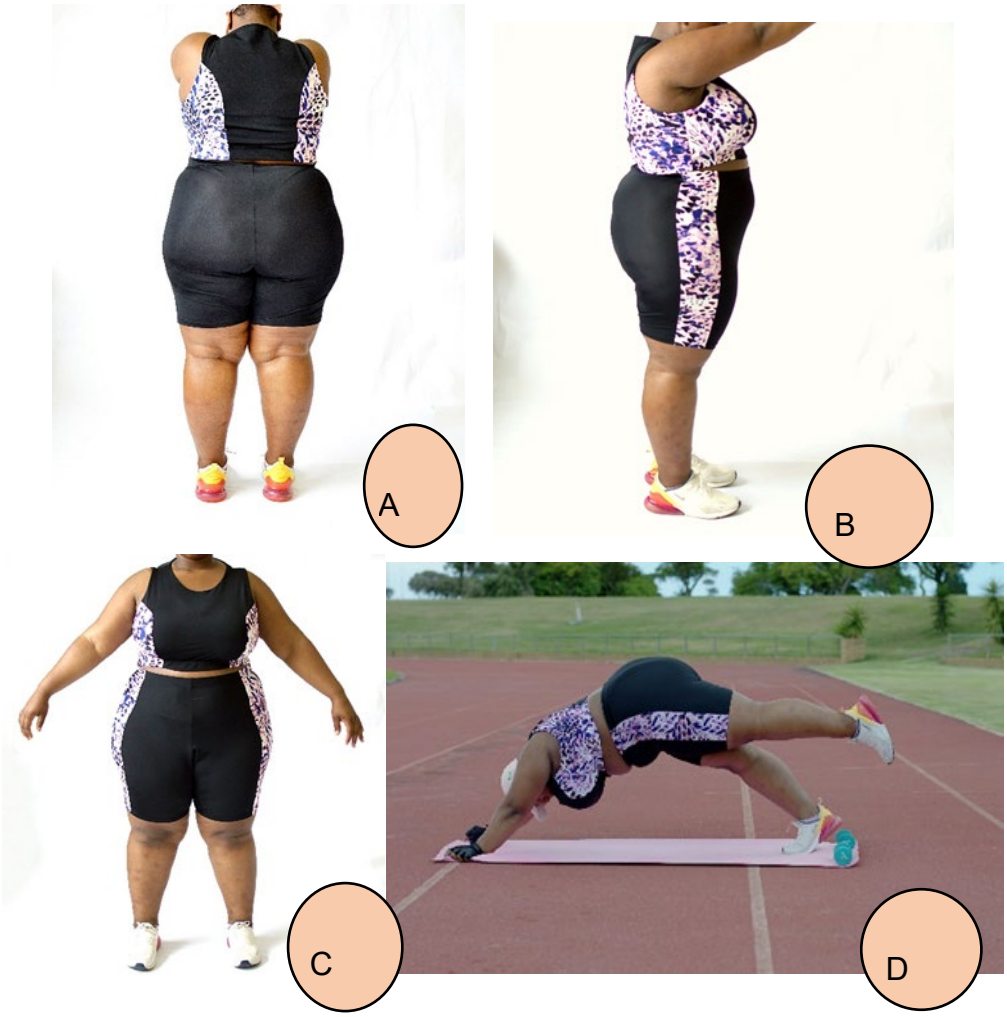

Figure 5.5. 7 Prototype 4 leggings worn by PZ2, size XXL

Figure 5.5.7 presents prototype 4. Participant Z2 fitted these leggings and was happy with the length of the short leggings as well as how the leggings fitted on her body. As shown in picture D, Participant Z2 is comfortable moving her legs up and down freely because the leggings are fitting her properly. The major problem identified in the survey was that the weight of the leggings currently available caused a rolling down and participants had to constantly pull the waist up to cover their stomach and back waist. Moreover, the

inaccurate body measurements were causing ill-fitting active-wear. Therefore, to evaluate the final prototypes these leggings, the researcher evaluated the leggings by assessing if they meet the requirements of the universal design. Table 5.5.2 presents the analysis of the final prototypes.

Table 5.5. 1 Store A, B & C leggings comparison with leggings prototype

Garment design	Problem areas	Legging basic block improvements	Interpretation
Store A & Store B	Shaped waistband seam restrict fabric from stretching enough for comfort. Limits movement / performance around stomach area. Fit rated poor and garment design failed	Elasticated facing and 3.5 elastic were used to improve design and silhouette. And to prevent waist from rolling or pulling down during the workout. Fit rated 5 which means participants were very satisfied with improved garment design.	Fit of the shaped waistband is not flattering and fitting properly for plus-size females. Facing was added to the prototype.
Store A & Store B Comfort & performance	Fit was not comfortable, Fabrics were not stretchy enough to allow flexibility	Fabrics used are flexible and stretchy for comfort and performance. Stretch & recovery test is 100%.	As fabrics can affect fit, suitable materials should be used.
Store A & Store B Size	Poor sizing	Correct measurements From Anthro-scan	There is a problem with the sizing system used for plus-size women.
Materials	Store A: 92% nylon, 8% elastane Store B: 89% polyester, 11% elastane Store B printed fabric Print fades when stretched to its limit and affects the look of the garment.	Fabric 1: 80% nylon, 20% spandex Fabric 2: 78% nylon, 22% spandex Fabric 3: 75% nylon, 15% spandex Printed fabric used stretch & recovers 100%. The print of the fabric remains the same and is not affected. The aesthetics of the garment was improved.	Fabrics used from Store A and B leggings are not flexible enough as compared to fabrics used for prototype. To test printed fabrics is important as it can affect the final look or fit of the garment.
Store C	Garment design – seamless tights which fitted better than leggings from Store A and B.	Elasticated facing and elastic is recommended.	Store C fabric, thickness covers cellulite and is better

	However, waist is rolling down during workout.		as compared to Stores A & B.

Table 5.5. 2 Analysis of the inclusive prototypes adopted form the universal design principles (Park et al. 2014)

Equitable use	The use of the accurate body measurements of Participant Z2 and Participant T1 were used to construct patterns of the prototypes. Fit was tested and pattern adjustments and alterations were made.
Flexibility in use	Fabrics were tested in CPUT textile lab to check the quality, comfort, and performance of the fabrics. The fabrics passed the tests and are approved as suitable for the active wear.
Perceptible information	The fabric colours were selected to produce a vibrant and stylish range. Participants rated the style '5' which means they are very happy. The prototype is motivating and boosting confidence of plus-size women.
Tolerance for error	Fabrics are tested for fabric performance, such as stretch and recovery, seam strength, and dimensional stability shrinkage % was -1% and stretchability % was + 0.75% which means it meets the tolerance for error. Pattern adjustments and second fit of the final prototype to suit the fabric type, and to fit perfectly to the plus-size female body.
Low physical effort	Final prototypes were tested by the plus-size female participants. Physical activities or movements was a requirement to test the performance of the prototype garment design, comfort as well as the fit in terms of the measurements that were used. The results were positive: the garment design and elasticated waistband passed the test, preventing the waist from rolling down. The materials were flexible and not restricting the wearer.
Size/space for use	Plus-size women's accurate body measurements were used to accommodate their size and body shape.
Intuitive use	Prototype design development has met the requirements of the garment manufacturing process; leggings basic block was constructed as the base foundation before styling the garment. Two fitting sessions were conducted to test and refine the fit of the leggings. Master patterns which are the styling of the leggings was constructed after the leggings basic blocks was altered and adjusted to perfectly fit the plus-size women's body. The final prototype is presented. The garment design on the first fit was rated '5' which means the participants were very happy with how the garment fits to their body. The fabrics also was rated '5' because it meets the performance standards. The overall rating of the prototype range was rated '5' because participants were very happy with the garment design as well as fabrics used.

5.5. Conclusion

According to the data collected from online surveys, plus-size women are not happy with the active-wear options that are currently available for them. Furthermore, the online survey revealed that women tend to have negative experiences when trying to find active-wear that fits well and comfortably on their bodies. During the fitting of the garment comparison of Store A and B fabrics used, but leggings were a bit tight and less stretchy, making the participants pull harder when trying on the leggings. The fit of leggings from Stores A and B was not proper with Participant Z2, but Store C leggings fit better on Z2 as compared to Stores A and B. This confirms a problem with women's plus-size active-wear. The design development was presented to draw recommendations for future studies.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

This research has shown that plus-size women are experiencing challenges with active-wear currently available in the market. These plus-size women shared their perceptions and frustrations with the clothing industry that excludes them by neglecting to design active-wear that accommodates their larger body size. The frustrations with the clothing market have diminished the self-esteem of many women since finding a properly fitting active-wear garment when shopping is almost impossible. There is a connection between clothing items and individuals' feelings (Evans, 2020). The lack of properly fitting active-wear has forced plus-size women to cope by altering the available active-wear with local designers to accommodate their body sizes. These difficult areas include bust, bicep, waist, hips and buttocks. Plus-size women also show an eagerness to participate in physical activities; however, they have been discouraged by a lack of active-wear gear that they perceive as motivating and aesthetically pleasing. The aim of this research was to investigate plus-size women's experiences regarding fit satisfaction levels, and their perception about active-wear to improve fit, functionality and clothing aesthetics. Data gathered from plus-size women pertaining to the currently available active-wear enabled the researcher to draw several conclusions and offer insightful recommendations.

Data were collected in the areas around Cape Town and the plus-size women participants were recruited using the social media platforms. The survey, designed using Google forms, was distributed via email and by using WhatsApp group as a platform for communication between participants and the researcher. The researcher has followed an iterative process approach whereby the design development of the prototype was an on-going process from the analysis of the survey investigating fit satisfaction levels of plus-size females, followed by further investigation where the researcher conducted active-wear garment comparisons to analyse fit and evaluate by fitting three pairs of leggings bought from three local stores. Thereafter, the collection of accurate body measurements of plus-size females through anthropometric 3D body scan was conducted. Plus-size

body measurements were used to construct the base foundations of leggings basic blocks that were tested to make ensure comfortable fit before the process of styling a final pattern of the prototypes. Fabrics were tested to ensure suitability for the prototypes followed by the assembly process of the final garments. These prototypes were fitted again by the participants and fit was evaluated where plus-size female participants performed physical movements to test the garment design improvements of the researcher. As this was the final phase of this research, the researcher is proposing that other researchers explore the second fit of these final active-wear prototypes.

The following research questions were administered to participants using methods that were best suited to answer the research questions.

6.2. Research main question

What are plus-size females' experiences regarding fit satisfaction level, clothing choices and alternatives, including perceptions around aesthetics and purchasing behaviour pertaining to active-wear offered by local clothing retailers?

To answer the research main question, data revealed that the needs of plus-size women are not understood nor recognised regarding active-wear. Plus-size women often feel excluded and marginalised by the fashion industry, and this is even more apparent with active-wear. Active-wear for plus-size women in Cape Town, such as leggings (tights), tops and sports bras, has a definite fit problem. It is evident that South African clothing retailers must be more attuned to the larger-sized market to cater to their needs. Plus-size women often struggle to find active-wear that fits well and is comfortable. They often endure clothing that does not fit or that is not intended for active use. This frequently results in frustration and dissatisfaction.

6.2.1. Sub-question 1

Why is there a fit problem – if any – with active-wear apparel such as leggings (tights), tops and sports-bras for plus-size women in Cape Town?

To answer the first sub-question, several issues have been identified in areas of the garment industry that can be modified to improve the performance and fit of plus-size

women's active-wear. Inconsistency with sizing was a major challenge that plus-size women emphasised. This means that many plus-size women must buy active-wear that is either too big or too small, which can lead to poor fit and bodily discomfort and damage. Another problem is that active-wear for plus-size women is often made from poor quality materials that do not hold up well to wear and tear. This can lead to active-wear that is uncomfortable or does not last long. Another problem is that many active-wear companies do not offer a full range of sizes for plus-size women.

6.2.2. Sub-question 2

How can the identified problems in apparel be altered to improve fit and performance of the active-wear for plus-size females?

To answer sub-question two, practice-led research was conducted to develop the design process for an inclusive prototype adopted from the universal design principles (Park et al., 2014). Different phases following an iterative approach where problematic areas regarding fit of active-wear for plus-size women were identified. The researcher applied her skills in clothing and textile by constructing patterns to improve garment design as well as testing fabrics in the textile laboratory to propose solutions to better the fit and endurance of active-wear for plus-size women.

6.3. Aims and objectives of the research

The main aim of this research was to propose inclusive designs of active-wear that accommodate plus-size women. To achieve this aim, the following objectives were employed.

- To investigate experiences regarding fit satisfaction levels, clothing choices and alternatives, including perceptions around aesthetics and purchasing behaviour pertaining to active-wear offered by clothing retailers.

Plus-size women have expressed their major concerns regarding active-wear currently available in the market through the online survey as presented in Chapter 4 and analysed in Chapter 5. Therefor the first aim of this research was achieved.

- To investigate factors affecting fit regarding plus-size active-wear.

Factors that were discovered in this research were the inaccurate sizing system applied by clothing manufactures and clothing retailers to design various clothing items for plus-size women, some fabrics used can also affect fit of active-wear as a results it is important to conduct textile laboratory test to test fabric performance and comfort. Leggings basic blocks and final patters of the prototype range were designed and tested to improve fit for active-wear for plus-size women.

- To evaluate the fit satisfaction with plus-size females active-wear, focusing on problematic areas that were identified by the participants and develop an inclusive design prototype.

To evaluate the fit satisfaction with plus-size females active-wear, focusing on problematic apparel areas that were identified by the participants. Plus-size women identified problem areas that affect the fit of active-wear and gave further reasons for poor fit. It is evident that there are many factors affecting fit, for example, a lack of an accurate South African body sizing system, poor quality and poor fabrics. Therefore, designers should re-assess the current sizing and select suitable fabrics for better performance and comfort. Prototypes were designed to test the fit and to understand plus-size body shapes and larger women's preferences.

The researcher considered the feedback from the online survey and the active-wear garment comparison of active-wear currently available to propose solutions to improve the fit. These proposals were factored in the prototypes that were developed.

Plus-size women want to find active-wear that is both stylish and functional. Retailers need to be more inclusive and offer a wider range of sizes to meet the needs of this large market. Many stores that cater to this demographic do not offer a wide range with correct and accurate sizes to truly fit a plus-size woman. The products in the market are often too tight or too loose in the wrong places, as the garment comparison of Stores A, B and C support that indeed the inconsistency of the sizes affects the fit of active-wear. This can

be very frustrating for plus-size women trying to live an active lifestyle as they may not be able to find the right clothing to support their activities. As a result, many plus-size women feel excluded from the active-wear market and feel compelled to compromise fit of the garments or even go without the clothes they need to feel comfortable and supported while exercising.

6.5. Recommendations

In response to the second sub-question there are several ways to address this problem, one recommendation is that active-wear manufactures/retailers should start offering plus-size options for plus-size women because currently the choice is limited. In this way, plus-size women could find the right active-wear that would improve performance and comfort as well as boosting their confidence. Another recommendation is to use higher quality materials in plus-size women's active-wear. This would make active-wear more comfortable and last longer, it would improve the performance and fit of plus-size women's active-wear.

From the prototype range, the following solutions or proposals of designing and developing comfortable and properly fitting active-wear for plus-size females are offered:

1. *Garment design – The s*haped waistband design can be substituted by using elasticated waistband for better garment performance, to improve fit and to suit the body shape of plus-size females.
2. *Manufacturing production* – by eliminating the seam operation that is in-between the shaped waistband and the bottom of the leggings bought from stores A and B, it can increase the productivity and lead time.
3. *Selection of fabrics and testing* – prototypes can be designed and tested to make pattern adjustments to suit the fabric. A second fit of the final products of the prototype is required to improve the fit of the prototype, and pattern adjustments are needed to suit the fabrics used.

Using the information that was gathered through the survey with plus-size women and from the researcher’s active-wear garment comparison to further investigate and evaluate fit of active-wear currently available in the market, the researcher developed an inclusive

prototype range based on the needs of plus-size women, according to the universal design principles (Park et al., 2014; refer to Table 5.5). The main aspects to produce inclusive designs and accurate body measurements of the participants were to improve fit, so fabrics were tested for strength and comfort. The evidence from the data collection revealed that current active-wear available is not suitable for plus-size female body shapes. While most women wear what is available to them, they are typically not happy and confident with what is available to wear.

Another recommendation is that the clothing industry and local designers should collaborate and study plus-size women body shapes to develop accurate sizing standards that will then be employed to design inclusive active-wear. Clothing retailers should participate in the practical studies where observations and testing of active-wear garments will be evaluated. It is important for researchers and the clothing industry to involve plus-size women in the co-developing of active-wear to understand their preferences.

6.6. Contribution to knowledge

The information gathered in this research will add value to the limited body of knowledge as plus-size women's studies related to fit. The researcher's interest and intentions were to evaluate the fit of active-wear currently offered to plus-size women. The researcher aims to contribute further to the new size development chart of plus-size women. This would improve the fit of not only active-wear but full-size apparel in general which will also encourage and motivate plus-size women and boost their self-esteem. The study contributes to the positive body image of plus-size women by improving active-wear prototypes. These positive responses were made after testing of the final prototypes regarding improved fit, better colour choice, and the styling as reflected in the aesthetics of the complete range.

6.7. Limitations of the research

To achieve the primary aim of this research, it was necessary to involve a wide spectrum of the South African manufacturers and retailers currently offering plus-size active-wear

for women. However, due to time constraints and ethical requirements to conduct this study, there was little time to acquire consent forms to involve experts from the manufacturers producing active-wear. In the recruitment processes, the researcher chose to select participants but had a limited number of respondents as others who could potentially contribute are not on social platforms. Also, the researcher aimed to get participants from diverse cultures, but again, due to limitations encountered in the recruitment process, it was challenging to find different ethnic groups. As data related to this topic is not available in South Africa, this resulted in a limited review of literature.

One of challenges the researcher also encountered while conducting the survey was that most women had difficulty opening the link that was sent by the researcher on their phones. The researcher was delayed completing the sewing process of the final prototype products due to the delay in receiving the fabrics from the supplier. Also, due to financial constraints, the researcher could not conduct the second fit evaluation of the final product to further improve the fit of these active-wear prototypes. However, this research has opened a platform for other researchers to further explore this area of study, by analysing factors affecting fit of plus-size active-wear and contributing to the extensive development of an appropriate Afro-centric size chart for South African women.

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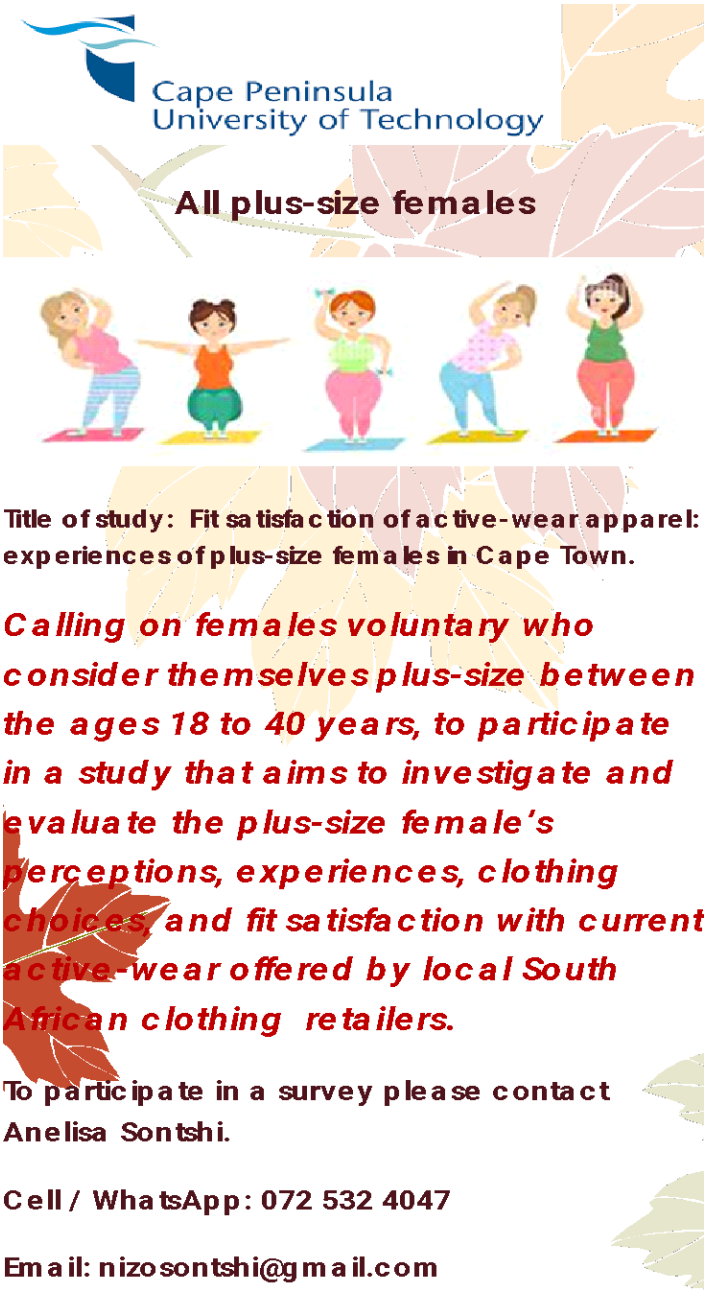
APPENDICES

Appendix A: Online-survey invitation poster



Appendix B: Online-survey consent form

Introductory letter for the collection of research data

Anelisa Harmony Sontshi is registered for the M Tech Applied Design degree at CPUT (210186372). The thesis is titled **Fit satisfaction of active-wear apparel: experiences of plus-size females in Cape Town** and aims to investigate the experiences of the plus-size women group in sourcing active-wear that is functional, aesthetic, fits, comfortable and performs.

The supervisor(s) for this research is/are:
Principal Supervisor: Dr. Doice Moyo
Co-Supervisor: Dr. Alettia Chisin

In order to meet the requirements of the university's Higher Degrees Committee (HDC) the student must get consent to collect data from organisations which they have identified as potential sources of data. In this case the student will use interviews, online surveys, observational field research and a pre-test and post-test to gather data.
If you agree to this, you are requested to complete the attached form (an electronic version will be made available to you if you so desire) and print it on your organisation's letterhead.

For further clarification on this matter please contact either the supervisor(s) identified above, or the Faculty Research Ethics Committee secretary (Ms V Naidoo) at 021 469 1012 or naidoove@cput.ac.za.

Yours sincerely

Dr. Doice Moyo
20 August 2019

I **……**, in my capacity as ……..**……** at **…….** give consent in principle to allow **Anelisa Sontshi** a student at the Cape Peninsula University of Technology, to collect data as part of her M Tech (Applied Design) research. The student has explained to me the nature of his/her research and the nature of the data to be collected.

This consents in no way commits any individual staff member to participate in the research, and it is expected that the student will get explicit consent from any participants. I reserve the right to withdraw this permission at some future time.

In addition, the participant's name may or may not be used as indicated below. (Tick as appropriate.)

	Thesis	**Conference paper**	**Journal article**	**Research poster**
Yes				
No				

_____ _____

<<Insert name>> *<<insert date>>*

Appendix C: Online-survey questions

Master of Technology: Applied Design, in the Faculty of Informatics and Design at the Cape Peninsula University of Technology

Title: Fit satisfaction of active-wear apparel: experiences of plus-size females in Cape Town.

Aim of the study

This research aims to investigate and evaluate plus-size female's perceptions, clothing choices, alternatives if any and fit satisfaction levels with active-wear that is currently offered by clothing retailers. The focus is to evaluate the fit of these garments and express how comfortable they are and how would one rate the performance of these garments during any physical activity. This research is focusing on evaluating the garments such and tights or leggings, top and sport bras, rating the fit satisfaction level of active-wear apparel on garment areas such as bust, bicep, waist, hips, thigh, and crotch length front and back rise. The other important factor is to investigate current issues that plus-size females experiences when making purchase decisions. This study will identify factors that can be used to improve fit and consumer satisfaction with active-wear apparel to achieve better performance for plus-size females.

Student: Ms. Anelisa Harmony Sontshi
Supervisor: Dr. D Moyo
Co-supervisor: Dr. A

Protection of confidentiality and voluntary participation

I wish to assure you that the personal information of the respondents will be confidential. No one is forced to answer the questionnaire. However, your input to this study is very important to ensure the success of this research project. Your participation is voluntary, and you can quit anytime during the study.

The questionnaire

The questionnaire consists of TWO sections and it should take you about 10-15 minutes to complete. Thank you for your valued participation.

Section A: Qualitative online Questionnaire)

The questions below address your perceptions and overall apparel fit satisfaction with active-wear.

Apparel fit is considered as one of the important factors that influence apparel comfort and is considered in the functionality of the garment that will not restrict the movements of the wearer while it is fulfilling its performance.

Please read the following question and rate the level of satisfaction from 1 - 5. 1- Poor, 2 – Bad, 3- Moderate, 4-Good 5- excellent).
What is your overall fit satisfaction with current active-wear offered by South African clothing retailers?

1	**2**	**3**	**4**	**5**

Please read the following statements and rate the level of satisfaction from 1 - 5. 1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree 5- Strongly).

Overall, I am pleased with how the leggings or tights fits me.

1	**2**	**3**	**4**	**5**

Overall, I am pleased with how the tops fits me

Overall, I am pleased with how the sport bras fits me.

Overall, my shopping experience is easy I do not struggle to get active-wear for plus-size.

1	**2**	**3**	**4**	**5**

General background information
Please fill in the appropriate sections and spaces.
How often do you participate in any physical activity?

Always	**Seldom**	**Unlikely**	**Never**	

Please supply your age.

Which ethnic group do you fall under? Tick appropriate block

African	**Coloured**	**Indian**	**White**	**Other**

Section B: Opening questions: overall concerns of active-wear apparel fit.
What are your major concerns about fit when you purchase active-wear apparel?

Perceptions of active-wear apparel fit.
What does good fit in active-wear apparel mean to you? And What kind of criteria do you follow to ensure that fit is good in active-wear apparel?

What does bad fit mean in active-wear apparel to you? And what kind of criteria do you follow to illustrate that fit is poor in active-wear apparel?

In general, what are your experiences with active-wear apparel fit? Bad or good? Please give some examples as to why you have had these experiences.

When you go shopping, which garment area in active-wear give you the most problem with fit?

Bust	**Waist**	**Hips**	**Hips**	**Bicep**	**Back crutch line**

With reference to the question above, to the list of garment areas, which body areas experience problems most in terms of fit? You can write short answer.

Is fit an important factor to you when shopping for active-wear? Please explain why or why these factors are important/not so important to you.

How important are the following factors when considering your active-wear? (Please rate the importance with 1 being least important, 5 being most important).

Aesthetics / style	**Fit**	**Functionality**	**Comfort**

Performance — Apparel Fit Satisfaction
Think about the active-wear you have purchased in the last two years. Can you remember when it did not perform well? Tell me about the example. Why did it not perform well? Please explain.

Situation
Think about the active-wear you have purchased in the last two years. Can you remember the last time you were disappointed with your garments e.g. it did not fulfil its purpose when performing any physical activity?

Comfort and fit
How is comfort related to fit? For example, sport bra fit is causing discomfort, they are too tight and squashing breast.

Scenario: Purchase decision
Think about a situation that might occur; a hypothetical situation: When you are shopping for clothing, you find a garment that you really like - you like the colour, fabric, and style. But for some reason, the garment does not fit well. What do you do?

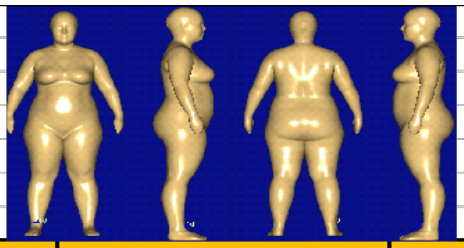
What suggestions do you have that could assist South African clothing retailers to improve fit of active-wear for plus-size females?

Any other comments are most welcome

Thank you for your time and effort!

Appendix D: Anthropometric body scan measurements and image, Participant T1 size large

3D BodyScanning Anthroscan					
Date	23 October 2022				
Name/Code	Large participant				
Age					
Gender	Female				
Province					



	Measurement Names	M		Measurement Names	M
No	Overview	[cm] [degree]	No	Overview	[cm] [degree]
1	Body height	155.7	27	Arm length left	53.3
2	Cervical height	136.6	28	Arm length right	53.8
3	Waist height	96	29	Upper arm length left	30.4
4	Crotch height	67.6	30	Upper arm length right	31
5	Knee height	41.9	31	Upper arm girth left	37.4
6	Breast height	111.4	32	Upper arm girth right	37.5
7	Trunk length	67.6	33	Elbow girth left	27.9
8	Mid neck girth	36.7	34	Elbow girth right	28.1
9	Shoulder width left	12.4	35	Forearm girth left	24.7
10	Shoulder width right	12.3	36	Forearm girth right	25
11	Shoulder angle left	21.1	37	Wrist girth left	17
12	Shoulder angle right	21.6	38	Wrist girth right	17
13	Bust points width	22	39	Sideseam at waist left	97.1
14	Neck right to waist over bust	46.9	40	Sideseam at waist right	97.2
15	Bust point to neck left	30.3	41	Thigh girth left (horizontal)	73.9
16	Bust point to neck right	30	42	Thigh girth right (horizontal)	74.3
17	Bust/chest girth (horizontal)	110.3	43	Knee girth left	46
18	Across Back Width	37	44	Knee girth right	45.9
19	Neck to waist center back	39.3	45	Upper knee girth left	52.8
20	Crotch length	80.7	46	Upper knee right	52.8
21	Waist girth	98.4	47	Lower knee girth left	42.5
22	Waist to buttock height right	18.9	48	Lower knee girth right	42.6
23	High hip girth	113.7	49	calf girth left	45.6
24	Buttock girth	122	50	calf girth right	45.5
25	Arm length to neck back left	72.2	51	min. leg girth left	25.7
26	Arm length to neck back right	72.8	52	min. leg girth right	25.5

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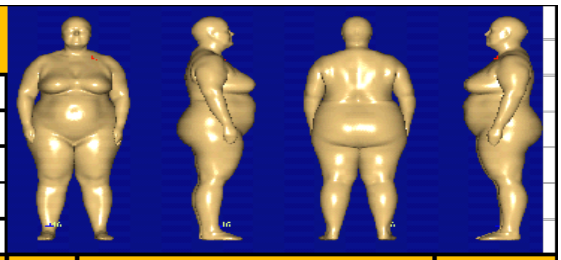
Appendix E: Anthropometric body scan measurements and image, Participant Z2 size XXL

3D BodyScanning Anthroscan					
Date	23 October 2022				
Name/Code	2XL Participant				
Age					
Gender	Female				
Province					



	Measurement Names	M		Measurement Names	M
No	Overview	[cm] [degree]	No	Overview	[cm] [degree]
1	Body height	164.5	27	Arm length left	61.1
2	Cervical height	145.8	28	Arm length right	59.8
3	Waist height	100.9	29	Upper arm length left	35.3
4	Crotch height	68.9	30	Upper arm length right	34.2
5	Knee height	43.9	31	Upper arm girth left	44.8
6	Breast height	115.5	32	Upper arm girth right	45.4
7	Trunk length	74.8	33	Elbow girth left	33.5
8	Mid neck girth	42.3	34	Elbow girth right	33.4
9	Shoulder width left	14	35	Forearm girth left	27.8
10	Shoulder width right	14.8	36	Forearm girth right	29.2
11	Shoulder angle left	24.5	37	Wrist girth left	18
12	Shoulder angle right	22.7	38	Wrist girth right	19.4
13	Bust points width	27	39	Sideseam at waist left	102.1
14	Neck right to waist over bust	56	40	Sideseam at waist right	102.5
15	Bust point to neck left	38.8	41	Thigh girth left (horizontal)	86.6
16	Bust point to neck right	38.6	42	Thigh girth right (horizontal)	87.3
17	Bust/chest girth (horizontal)	137.6	43	Knee girth left	53.6
18	Across Back Width	43.3	44	Knee girth right	53.3
19	Neck to waist center back	43.5	45	Upper knee girth left	62.3
20	Crotch length	120.7	46	Upper knee right	62.2
21	Waist girth	129.4	47	Lower knee girth left	49.2
22	Waist to buttock height right	19.6	48	Lower knee girth right	49.1
23	High hip girth	145.7	49	calf girth left	52.8
24	Buttock girth	149	50	calf girth right	52.6
25	Arm length to neck back left	82.6	51	min. leg girth left	28.9
26	Arm length to neck back right	82.3	52	min. leg girth right	28.7

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Appendix F: Online survey comments and suggestions

Final Comments from Respondents
I enjoyed the question hope the study can assist woman in south Africa
It was a pleasure doing this survey, all the questions posed evoked some thoughts in being a plus-size woman. Plus size women should be catered for as well in active wear with broad choices to choose from.
Plus size woman should have a wide range aisles; they also deserve to shop without stress of not finding garment they are looking for.
The advice I would give for plus-size women is to wear clothes that they are comfortable at wearing. That will help them to boost their confidence and make them feel good at all times.
Gym wear is really comfortable for me
Designers should also accommodate people with big butt by ensuring the pants fully cover the backs.
Extension or trying for jeans to be putted a pastiche like material by the waistline
Sport bra must not have those moving sponge inside them
More plus-size clothing in retails
It is hard to find perfect fit for plus-size
Designers should use African women measurements when designing garments
Designers must consider African plus-size measurements when designing clothes
Stylish active wear for plus-size would do
Stylish active wear for plus-size will be appreciated
Shops must have more clothes for plus-size women too

Participant G: T1 final prototype feedback form

Active-wear Prototype feedback form

Participant T1

Master of Technology: Applied Design, in the Faculty of Informatics and Design at the Cape Peninsula University of Technology

Title: Fit satisfaction of active-wear apparel: experiences of plus-size females in Cape Town.

Aim of the study

This research aims to investigate and evaluate plus-size female's perceptions, clothing choices, alternatives if any and fit satisfaction levels with active-wear that is currently offered by clothing retailers. The focus is to evaluate the fit of these garments and express how comfortable they are and how would one rate the performance of these garments during any physical activity. This research is focusing on evaluating the garments such and tights or leggings, top and sport bras, rating the fit satisfaction level of active-wear apparel on garment areas such as bust, bicep, waist, hips, thigh, and crotch length front and back rise. To evaluate fit of active-wear online survey was conduct, followed by comparative study where leggings were purchased to assess the fit of current active-wear. The last phase is to evaluate the prototypes (samples) to further assess the fit. Conclusion and recommendations to address fit problems of active-wear will be drawn after this stage.

Please read the following question and rate the level of satisfaction from 1 - 5.

1- Poor, 2 – Bad, 3-Moderate, 4-Good, 5- excellent).

What is your overall fit satisfaction with active-wear prototype?

1	**2**	**3**	**4 x**	**5**

Overall, I am pleased with how the leggings or tights fits me.

1	**2**	**3**	**4**	**5 x**

Overall, I am pleased with how the tops fits me

1	**2**	**3**	**4 x**	**5**

Overall comfortability of the fabrics used.

1	**2**	**3**	**4**	**5 x**

Overall, please rate the style/ aesthetics.

1	**2**	**3**	**4**	**5 x**

Please comment about Performance of leggings and Fit Satisfaction level. Moving around in the leggings felt very comfortable, I could run, kick, squat without feeling constricted, my satisfaction level is good, the range of colour was also fun.
What suggestions do you have that could improve fit of active-wear prototype? Because of the stretch of fabric, the leggings would fit better if they can be adjusted. Overall very compatible and stylish.

Appendix H: Participant Z2 final prototype feedback form

Active-wear Prototype feedback form

Participant Z2

Master of Technology: Applied Design, in the Faculty of Informatics and Design at the Cape Peninsula University of Technology

Title: Fit satisfaction of active-wear apparel: experiences of plus-size females in Cape Town.

Aim of the study

This research aims to investigate and evaluate plus-size female's perceptions, clothing choices, alternatives if any and fit satisfaction levels with active-wear that is currently offered by clothing retailers. The focus is to evaluate the fit of these garments and express how comfortable they are and how would one rate the performance of these garments during any physical activity. This research is focusing on evaluating the garments such and tights or leggings, top and sport bras, rating the fit satisfaction level of active-wear apparel on garment areas such as bust, bicep, waist, hips, thigh, and crotch length front and back rise. To evaluate fit of active-wear online survey was conduct, followed by comparative study where leggings were purchased to assess the fit of current active-wear. The last phase is to evaluate the prototypes (samples) to further assess the fit. Conclusion and recommendations to address fit problems of active-wear will be drawn after this stage.

Please read the following question and rate the level of satisfaction from 1 - 5.

1- Poor, 2 – Bad, 3-Moderate, 4-Good, 5- excellent).

What is your overall fit satisfaction with active-wear prototype?

1	2	3	4	5 x

Overall, I am pleased with how the leggings or tights fits me.

1	2	3	4	5 x

Overall, I am pleased with how the tops fits me

1	2	3	4 x	5

Overall comfortability of the fabrics used.

1	2	3	4 x	5

Overall, please rate the style/ aesthetics.

1	2	3	4	5 x

Please comment about Performance of leggings and Fit Satisfaction level. I felt very comfortable with the leggings and top prototypes. Fabrics are very flexible that I can move freely without feeling restricted. I love the prototype range, I would buy it, it boosted myself confidence. I love the elasticated waistband, when I was testing it by doing exercises the leggings were not rolling or pulling down, I was happy. The leggings covered my buttocks up to my natural waistline, which was the challenge that I am experiencing when purchasing active-wear. I would be happy to get a proper fit for my size.
What suggestions do you have that could improve fit of active-wear prototype? I think pattern adjustment is needed because the tights were feeling a bit looser. Second fit maybe would be better, but overall am happy.

Appendix I: Participant L3 final prototype feedback form

Active-wear Prototype feedback form

Participant L3

Master of Technology: Applied Design, in the Faculty of Informatics and Design at the Cape Peninsula University of Technology

Title: Fit satisfaction of active-wear apparel: experiences of plus-size females in Cape Town.

Aim of the study

This research aims to investigate and evaluate plus-size female's perceptions, clothing choices, alternatives if any and fit satisfaction levels with active-wear that is currently offered by clothing retailers. The focus is to evaluate the fit of these garments and express how comfortable they are and how would one rate the performance of these garments during any physical activity. This research is focusing on evaluating the garments such and tights or leggings, top and sport bras, rating the fit satisfaction level of active-wear apparel on garment areas such as bust, bicep, waist, hips, thigh, and crotch length front and back rise. To evaluate fit of active-wear online survey was conduct, followed by comparative study where leggings were purchased to assess the fit of current active-wear. The last phase is to evaluate the prototypes (samples) to further assess the fit. Conclusion and recommendations to address fit problems of active-wear will be drawn after this stage.

Please read the following question and rate the level of satisfaction from 1 - 5.

1- Poor, 2 – Bad, 3-Moderate, 4-Good, 5- excellent).

What is your overall fit satisfaction with active-wear prototype?

1	**2**	**3**	**4 x**	**5**

Overall, I am pleased with how the leggings or tights fits me.

1	**2**	**3**	**4**	**5 x**

Overall, I am pleased with how the tops fits me

1	**2**	**3 x**	**4**	**5**

Overall comfortability of the fabrics used.

1	**2**	**3**	**4**	**5 x**

Overall, please rate the style/ aesthetics.

1	**2**	**3**	**4**	**5 x**

Please comment about Performance of leggings and Fit Satisfaction level. The leggings were perfectly comfortable and fitting but fit of the fabric was a bit looser. The texture of the fabrics was okay I am happy with it.
What suggestions do you have that could improve fit of active-wear prototype? Because it was feeling a bit looser on the body, alterations are needed or use material that is not loose. Overall everything was okay.

Appendix J: Construction breakdown of leggings used in the assembly process

Prototype 1

Construction breakdown: Black leggings with mesh and faced waistband			
Preparation			
Stitches per cm: 7			
Machinery type: Mocksafety and plainstitch			
No.	**Operation**	**Machine type**	**Attachments work aids**
1.	Attach leggings middle pieces 1 to top pieces	Mocksafety	-
2.	Attach leggings middle pieces to middle pieces 1	Mocksafety	-
	Attach bottom pieces to middle pieces	Mocksafety	-
3.	Prepare elastic	Plainstitch	-
Comments:			

Construction breakdown: Black leggings with mesh and faced waistband			
Assembly			
Stitches per centimetres: 7			
Machinery type: Mocksafety and cover seam machine			
No.	**Operation**	**Machine type**	**Attachments work aids**
1.	Close front crotch	Mocksafety	-
2.	Close back crotch	Mocksafety	-
3.	Attach hanger lops to front and back crotch seams	Plainstitch	-
4.	Close inside seam	Mocksafety	-
5.	Baste elastic to leggings faced waistband	Plainstitch	-
6.	Fold and hem faced waistband	Coverseam	Seam guide
7.	Hem leggings	Coverseam	Seam guide
Comments: Hanger loops are attached on front and back crotch seams for hanger appeal. Careful handling should be applied when hemming the elasticated faced waistband to avoid twisting or shifting elasticated faced waistband.			

Construction breakdown: Black leggings with mesh and faced waistband			
Finishing and pressing			
No.	**Pressing operation**	**Pressing equipment**	**Techniques**
1.	Flat steam press waistband and hem	Steam press iron	
2.	Steam press inside seams on a hanger	Steam press iron	

Packaging:
Comments:

Prototype 2

Construction breakdown: Printed leggings – three quarter length			
Preparation			
Stitches per cm: 7			
Machinery type: Mocksafety and plainstitch			
No.	**Operation**	**Machine type**	**Attachments work aids**
1.	Prepare elastic	Plain stitch	-
2.	Prepare waistband	Plainstitch	-
3.	Baste elastic to waistband	Plainstitch	-
Comments: Careful handling should be applied when basting the elastic to waistband to avoid shifting of waistband material which might result into bubbling on waistband.			

Construction breakdown: Printed leggings – three quarter length			
Assembly			
Stitches per centimetres: 7			
Machinery type: Mocksafety, plainstitch and cover seam machine			
No.	**Operation**	**Machine type**	**Attachments work aids**
1.	Close front crotch	Mocksafety	-
2.	Close back crotch	Mocksafety	-
3.	Attach front back panel	Mocksafety	-
4.	Close inside seam	Mocksafety	-
5.	Attach hanger loops on both side seams	Plain stitch	-
6.	Attach elasticated waistband to leggings	Mocksafety	-
7.	Hem the leggings left and right	Coverseam	Seam guide
Comments: Hanger loops are attached on front and back crotch seams for hanger appeal.			

Construction breakdown: Printed leggings – three quarter length			
Finishing and pressing			
No.	**Pressing operation**	**Pressing equipment**	**Techniques**
1.	Flat steam press waistband and hem	Steam press iron	
2.	Steam press inside seam and inside seam on a hanger	Steam press iron	
Packaging:			

Comments:

Prototype 3

Construction breakdown: Black leggings with side panel power mesh			
Preparation			
Stitches per cm: 7			
Machinery type: Mocksafety and plainstitch			
No.	**Operation**	**Machine type**	**Attachments work aids**
1.	Attach mesh to left front side seam	Mocksafety	-
2.	Attach mesh to right side seam	Mocksafety	-
3.	Prepare elastic	Plainstitch	-
Comments:			

Construction breakdown: Black leggings with side panel power mesh			
Assembly			
Stitches per centimetres: 7			
Machinery type: Mocksafety, plainstitch and cover seam machine			
No.	**Operation**	**Machine type**	**Attachments work aids**
1.	Close front crotch	Mocksafety	-
2.	Close back crotch	Mocksafety	-
3.	Attach front to back panel	Mocksafety	-
4.	Attach hanger lops to front and back crotch seams	Plainstitch	-
5.	Attach back to front panel	Mocksafety	-
6.	Close inside seam	Mocksafety	-
7.	Baste elastic to leggings faced waistband	Plainstitch	-
8.	Fold and hem faced waistband	Coverseam	Seam guide
9.	Hem leggings	Coverseam	Seam guide
Comments: Hanger loops are attached on front and back crotch seams for hanger appeal. Careful handling should be applied when hemming the elasticated faced waistband to avoid twisting or shifting elasticated faced waistband.			

Construction breakdown: Black leggings with side panel power mesh			
Finishing and pressing			
No.	**Pressing operation**	**Pressing equipment**	**Techniques**

1.	Flat steam press waistband and hem	Steam press iron	
2.	Steam press inside seams and inside seam on a hanger	Steam press iron	
Packaging:			
Comments:			

Prototype 4

Construction breakdown: Black leggings with side printed side panel (short leggings)			
Preparation			
Stitches per cm: 7			
Machinery type: Mocksafety and plainstitch			
No.	**Operation**	**Machine type**	**Attachments work aids**
1.	Attach mesh to left front side seam	Mocksafety	-
2.	Attach mesh to right side seam	Mocksafety	-
3.	Prepare elastic	Plainstitch	-
Comments:			

Construction breakdown: Black leggings with side printed side panel (short leggings)			
Assembly			
Stitches per centimetres: 7			
Machinery type: Mocksafety and cover seam machine			
No.	**Operation**	**Machine type**	**Attachments work aids**
1.	Close front crotch	Mocksafety	-
2.	Close back crotch	Mocksafety	-
	Attach front to back panel	Mocksafety	-
3.	Attach hanger lops to front and back crotch seams	Plainstitch	-
4.	Attach back to front panel	Mocksafety	-
5.	Close inside seam	Mocksafety	-
6.	Baste elastic to leggings faced waistband	Plainstitch	-
7.	Fold and hem faced waistband	Coverseam	Seam guide
8.	Hem leggings	Coverseam	Seam guide
Comments: Hanger loops are attached on front and back crotch seams for hanger appeal. Careful handling should be applied when hemming the elasticated faced waistband to avoid twisting or shifting elasticated faced waistband.			

Construction breakdown: Black leggings with side printed side panel (short leggings)			
Finishing and pressing			
No.	**Pressing operation**	**Pressing equipment**	**Techniques**
1.	Flat steam press waistband and hem	Steam press iron	
2.	Steam press inside seams and inside seam on a hanger	Steam press iron	
Packaging:			
Comments:			

Appendix K: Ethical clearance certificate

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04 June 2021

Anelisa Harmony Sontshi
c/o Department of Applied Design
CPUT

Reference no: 210186372/2021/17

Project title: Fit satisfaction of active-wear apparel: experiences of plus-size females in Cape Town.

Approval period: 04 June 2021 – 31 December 2022

This is to certify that the Faculty of Informatics and Design Research Ethics Committee of the Cape Peninsula University of Technology approved the methodology and ethics of Anelisa Harmony Sontshi (210186372) for the MTech Design.

Any amendments, extension or other modifications to the protocol must be submitted to the Research Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

A/Prof I van Zyl
Chair: Research Ethics Committee
Faculty of Informatics and Design
Cape Peninsula University of Technology