A comparison of the body shapes of young Swazi women with those of body forms used in apparel manufacturing

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Dissertation

MconsSci (General)

Supervisor: Prof HM de Klerk

June 2012

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by

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Dissertation submitted in partial fulfilment of the requirements for the degree

Masters in Consumer Science (General)

in the

Faculty of Natural and Agricultural Science

Department of Consumer Science

University of Pretoria

Supervisor: Prof HM de Klerk

June 2012

This work is dedicated to my late mother Mrs EK Gama and father Mr HM Gama, who saw potential in me and invested in my education, taught me to stand for the truth at all times and lovingly channeled me towards striving towards being the best that I can be; my aunt Mrs TK Xuba, for being a mother to me and my siblings after my mother passed on; and lastly to my beloved husband and children for taking this journey with me.

DECLARATION

I, **Letsiwe Lindiwe Mabuza**, hereby declare that this dissertation which I submit for a **Masters in Consumer Science** degree at the University of Pretoria, is my original work and has not previously been submitted for a degree at any other University.

LETSIWE LINDIWE MABUZA

29 June 2012

ACKNOWLEDGEMENTS

I am fully and eternally indebted to the Almighty God for the execution of this work. I thank Him for graciously granting me the ability, will, strength, wisdom and finances necessary for successfully completing this programme.

A number of people have also in various ways contributed immensely toward the completion of this master's dissertation. To them, I will forever be infinitely indebted:

- I would like to express my earnest gratitude to my Supervisor, Professor Helena de Klerk, for her guidance, support and encouragement throughout the course of my study. I appreciate the intense discussions we engaged in and the substantial amount of your valuable time you afforded me;
- I owe a very special thank you to my husband and children. Thank you my darling, for walking this journey with me and for sincerely and wholly supporting me throughout. For always driving and accompanying me from Swaziland to the University of Pretoria for all my consultation meetings. My beloved children, Hlo, Milani, Hlumisa, Zoe and Hlelo, thank you for your love, support and understanding when I had to leave you in pursuit of my studies;
- Jacqui Sommervile and Karien Adamski, for their guidance and advice regarding the appropriate statistics and data analysis;
- Anne Mastamet-Mason, for training and guiding me on land marking and how and where to take body measurements;
- The University of Pretoria, for granting me a bursary for the programme;
- The University of Swaziland, for granting me study leave to pursue my studies;
- Trudie Erasmus, for editing and formatting my dissertation;
- Mr. Hlophe, the head teacher at St. Christopher's, for allowing me to conduct my research at his school;
- All the participants in the study, for granting me permission to take their body measurements;
- Dr. Anna-Mart Bonthuys, for proofreading and editing my dissertation;
- My research assistant Celiwe Matsebula, for her assistance during data collection;
- My lovely sisters, Lungi, Loma, Phetsie, Hlubi and Zuko, for their moral support, love and encouragement.

ABSTRACT

A comparison of the body shapes of young Swazi women with those of body forms used in apparel manufacturing

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In order to achieve good apparel fit, it is necessary to identify, define and classify the size and shape of a population based on a combination of key body measurements (Petrova & Ashdown, 2008). Unrepresentative sizing systems ultimately lead to apparel fit problems which are further compounded by an unstandardised and ambiguous communication of sizing and fit within the apparel manufacturing sector (Chun-Yoon & Jasper, 1996; Winks, 1997; Simmons & Istook, 2004).

According to Magagula and Zwane (2006), the sizing system used by the apparel industry in Swaziland is based on British anthropometric measurements taken in the 1940s; yet there is a significant variance in the body proportions and dimensions of different ethnic groups and within ethnic groups (Yu, 2004c:183). It is therefore predictable that young Swazi women would experience apparel fit problems with ready-to-wear apparel. Body forms are manufactured using body dimensions of the apparel manufacturer's target market in order to yield satisfactory levels of fit. This is however not the case for the Swazi market, as very little current anthropometric data exists on Swazi women. As a result, small-scale apparel manufacturers encounter problems with regard to body forms that are not manufactured according to the shape of Swazi women.

The aim of this research was therefore to identify and describe the most prevalent body shapes of young Swazi women using body dimensions, to identify and describe the body shapes of the currently used body forms through body dimensions, to describe and compare the most prevalent body measurements and proportions of young Swazi women and those of currently used body forms, and finally to test and evaluate the fit of the test garment which represents the most prevalent size and shape of the Swazi women, on the body forms. This study is explorative in nature as it helped to clarify a largely undefined area of body shape analysis in respect of young Swazi women. Under the quantitative research strategy, a survey research methodology was used. Anthropometric techniques and traditional tailor's measurements were used to obtain body measurements for various dimensions of young Swazi women, and training in anthropometry was undertaken to ensure that the measurements were taken reliably and accurately.

It emerges from the results of this study that the most prevalent body shape of young Swazi women is the triangular body shape, followed by the hourglass body shape, while the inverted triangle is the least common body shape. The two body form brands employed in this study on the other hand are found to bear different body shapes from each other. Though one brand appears to have the same shape as that of the most prevalent body shape of young Swazi women, it is apparent that there are notable differences regarding the degree of the body contours, i.e. the Swazi women are conspicuously heavier and more rounded at the hip area – as the measurement differences show. The expectation that this body form will offer a better fit to Swazi women as they have similar body shapes in principle, is not realised when the fit of the test garment is evaluated, due to the vast differences in the drop values. The fit problems that are predicted to be experienced by young Swazi women when using the body forms for pattern generation, based on the significant measurement differences, are indeed observed during the evaluation of the fit of the test garment on the body forms. The fit problems exhibited during the testing of the fit of the test garment based on the most prevalent body shape of young Swazi women on the body forms, are mainly due to a wider lower hip girth and shorter length proportions at the upper torso of the young Swazi women.

The results of this study contribute to a better understanding of the body shapes that exist among young Swazi women and the fit problems that young Swazi women experience as a consequence of unrepresentative body forms being used in terms of size and shape. Furthermore, the need for all stakeholders in the apparel manufacturing industry to reach consensus on the standardisation and communication of sizing emerges as a step toward affording better fitting apparel to the Swazi women.

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LIST OF ABBREVIATIONS/ACRONYMS

ASTM	American Society for Testing and Materials
ATC	Agreement on Textiles and Clothing
BSAS	Body Shape Analysis Scale
CAN	Canada
CCD	Couple Charge Device
CGBS	Canadian General Standards Board
CS	Commercial Standard
FFIT	Female Figure Identification Technique
ISO	International Organization for Standardization
VPS	Voluntary Product Standard
SADC	Southern African Development Community
SWASA	Swaziland Standards Authority
UK	United Kingdom
USA	United States of America

CHAPTER 1
THE STUDY IN PERSPECTIVE

1.1 INTRODUCTION, PROBLEM STATEMENT AND JUSTIFICATION

1.1.1 Introduction

The Swazi population is generally made up of one dominant ethnic group; however, the population is not entirely composed of the industry-focused ideal body type, but according to previous research, is dominated by the bottom-heavy body type (Magagula & Zwane, 2006:2). Body shapes are highly influenced by ethnicity, lifestyle, environmental factors and food, which are all factors that result in figure variations. These figure variations rarely occur in isolation but often occur in combination, e.g. a narrow waistline may occur in combination with a wide hip curve. These variation combinations then give typical body shapes, i.e. the hourglass ideal body shape, the triangular bottom-heavy body shape, the inverted triangular top-heavy body shape, the rectangular body shape and the rounded figure type (Rasband, 1994:14). Ethnic groups therefore have significant body shape differences – hence different fit problems (Winks, 1997). These significant differences lead to the fit problems experienced by Swazi women, as their clothing is made with a sizing system and tested on body forms based on a different ethnic group (Nkambule, 2010).

Body forms are fit models used to create patterns and fit clothing on, and are based on body conformations extracted from anthropometrical data. However, commercial body form standards are still unsatisfactory due to their limitations in terms of shape and accuracy (Yu, 2004a:35). For a body form to ensure fit, it should be conformed to the target market or population. For instance, if the garments are meant for the Swazi market, then the body forms used to produce those garments should depict the body shape of the Swazi population. The basis for the construction of body forms are body measurements. Although the circumferential measurements of the bust, waist and hips may appear to be similar, the shapes of figures may be quite different, hence require differently shaped figure forms to give an accurate fit. To address fit problems therefore, a set of current body measurement data for a specific target population is important in the development of measurement charts, which ought to be revised in ten-year cycles due to changes in the characteristics of a population (Brunn, 1983 in Mason 2008). Most developing countries, including Swaziland, use a clothing

sizing system that dates back to the 1940s (Magagula & Zwane, 2006:1; Mlauli, 2004:40). This therefore calls for the profiling of the body shapes of Swazi women.

Body shape analysis is the theory that buttresses the development of apparel sizing systems. Apparel sizing is based on averaged anthropometric body measurements that have to fit many body shapes within a size range, hence a sizing system includes a range of sizes based on graduation of dimensions for a body type (Connell, Ulrich, Knox, Hutton, Brunner & Ashdown, 2003). Fit is directly related to the anatomy of the human body and most of the fitting problems are created by the bulges of the human body (Yu, 2004a:31). Consumers use fit as an important measure for clothing appearance. Good fit eliminates the horrors of garment fit problems women have to deal with when shopping for new clothes. Gaping waistline, pants that bunch up between the legs, dresses drooping at the shoulders, skirts pulling at hiplines, or uneven hemlines are but a few of the common garment fit problems women are subjected to when shopping for new clothes. In a bid to improve the fit of purchased clothes, women often find themselves obliged to buy different sizes for the bottom and top of the same style and colour, make alterations after purchasing, or rely on expensive custom-made garments, which causes them to pay more for clothes. Not only does this add to clothing expenses, and is time consuming as women spend more time in fitting rooms, but it also eliminates the pleasure of being able to purchase ready-to-wear clothes.

A review of the sizing systems of several countries including the USA, Australia, England, Germany, Hungary, Japan and South Korea shows that there are variances in the many different size labelling systems in the world. Among other things, these variances in the many different sizing systems have caused some difficulties in marketing clothes abroad to diverse consumers due to fit problems (Chun-Yoon & Jasper, 1993:4). Despite the differences in sizing systems, it was noted that they are all based on a key dimension that is used to define the sizes within the system. The key dimension is generally distributed evenly across the system in an attempt to cover the broadest range of measurements, e.g. the waist measurements in sizes 2-10 are 2.5 cm apart, in sizes 12-16 they are 3.8 cm apart, and in size 18 and above, they are 5 cm apart. The remaining measurements, e.g. the hip which is the second most important dimension for design, are derived using regression statistics and averages related to the original key dimension (Shin & Istook, 2007; Apeagyei, 2010).

In a bid to solve the problem of poor fit in international markets, the International Standards Organization (1S0) developed an international size labelling system which was then used by many countries to adapt their respective labelling systems, hence adopting the 1S0 system. However, most authors concur that manufacturers and retailers believe that developing an international system defining size labelling codes with a specific set of body measurements

was not appropriate due to the anthropometric diversity among differing ethnic groups (Ashdown, 1998; Magagula & Zwane, 2006; Shin & Istook, 2007). According to the import and export customs and excise office in Swaziland, most of the apparel sold in chain stores in Swaziland are imported from South Africa and Asia (especially China). This is due to the implementation of the ATC (Agreement on Textiles and Clothing) in 2005, which paved the way for more cost-effective producers, for instance China and India, to increase their exports to global markets (Southern African Development Community (SADC) Trade, Industry and Investment Review Report, 2007/2008:237). The South African apparel manufacturers are using the sizing system adapted from the British sizing system, whilst China has its own sizing system suited to the Asian population (Mlauli, 2004:40). The South African clothing industry does not base its sizing system on any relevant research and it is further affirmed that the sizing system used in many chain stores are based on European body measurements (Mlauli, 2004:40). Consequently, women within the different body figure type size categories cannot find the right fit of garments within the current sizing system.

In recent years, the government of Swaziland has encouraged the nation to engage in entrepreneurial activities to fight unemployment and boost the economy of the country (Southern African Development Community (SADC) Trade, Industry and Investment Review Report, 2007/2008:231). In a bid to realise this initiative, the government through the Ministry of Economic Planning and Employment, consequently embarked on vigorous skills and entrepreneurship training sessions nationwide. This has seen a rise in the number of small-scale apparel manufacturers. Although armed with entrepreneurial and technical skills, small-scale apparel manufacturers encounter many problems with fit models (body forms) that are not manufactured according to the shape of the Swazi people, and therefore produce apparel that does not offer perfect fit.

1.1.2 Problem statement

Many of the problems of ill-fitting apparel have been blamed on the lack of standardisation of the sizing systems used by the apparel industry and sizing systems that are (in the case of Swaziland) based on British anthropometric measures performed in the 1940s (Magagula & Zwane, 2006). There is a significant variance in body proportions and dimensions between different ethnic groups and within ethnic groups (Yu, 2004c:183). Normally, figure forms are manufactured using body dimensions of the apparel manufacturer's target market in order to yield satisfactory levels of fit. This is not the case for the Swazi market as very little current anthropometric data exists on the Swazi women. As a result, small-scale apparel manufactures encounter problems with regard to figure forms that are not manufactured according to the shape of Swazi women. This exploratory study therefore seeks to establish

body profiles of Swazi women that can be used in the production of body forms used for the manufacturing of apparel sold to the Swazi population.

In Swaziland, the problem is further compounded by the fact that apparel sold in retail outlets is imported from other countries. There is therefore a need to establish comprehensive anthropometric data for the Swazi women as it forms the basis for shape analysis and sizing systems.

1.1.3 Justification of the study

To remain competitive in the current local and international retail market arena, the small-scale apparel manufacturers and retailers ought to manufacture and sell apparel that offer good fit to the target population. LaBat and DeLong (1990, cited by Pisut & Connell, 2007) support this view, stating the relationship between body shape, proportion, size and fit, personal and external influences, body cathexis and physical dimensions of the garment as important factors influencing fit. This study could lead to the development of body forms that offer better fit to Swazi women. Moreover, the study will contribute to consumer satisfaction in the purchase of apparel as they will enjoy the benefits of ready-to-wear clothing.

1.2 THEORETICAL BACKGROUND

The theoretical framework on sizing systems by Ashdown highlights four major factors that are influential in addressing sizing and fit problems, i.e. population measurements, design features, fit issues and communication of sizing and fit (Ashdown, 2007). The framework is complex as it encompasses all the factors that impact on fit. The framework cannot be used in its entirety for purposes of this study, as this study focuses mainly on female body shapes and proportions and how these compare to those of body forms currently used. Two main aspects highlighted by the framework, i.e. population measures and fit issues said to be crucial inputs for the identification of body shapes, and proportions in addressing sizing and fit problems will be the focus of this study. The representativeness of the population measurements was determined by using traditional tailor's measurements and traditional anthropometry. This led to the establishment of the Swazi female body shapes and the shapes of the body forms; these were then compared to establish any similarities and predict possible fit problems resulting from any differences.

Body measurement charts indicate the body measurements of a sample of the designated population, therefore establishing that the relationship between body size and shape in the provision of adequate clothing is important (Apeagyei, 2010). The association between the body size and shape of the body forms and those of the Swazi women needs therefore to be very strong to ensure that clothing draped on the body forms offer Swazi women well-fitting apparel. The communication of size through the size labelling of the body forms suggests to consumers the suitability of the body form or apparel for their body dimensions (Brown & Rice, 2001:42).

Fit is dependent on the anatomy of the human body; most fit problems are caused by the bulges and curves of the human body. Thus clothing that fits well conforms to the human body and allows ease of movement without strain (Yu, 2004a:31).

Having ascertained the measurement differences or similarities using body measurements, the perception of the fit of the most prevalent body shape test garment of Swazi women on the body forms had to be established by expect testers. In order to determine the efficiency of the body forms in producing well-fitting clothing for Swazi women, one first has to establish the body shapes of the Swazi women and those of the body forms. Furthermore, if there is any measurement differences between the two, one has to determine whether they are of any significance to impact on fit and predict the expected fit problems.

1.3 CONCEPTUAL FRAMEWORK AND RESEARCH OBJECTIVES

1.3.1 Conceptual framework

The conceptual framework (**Figure 1.1**) was developed against the backdrop of Ashdown's theoretical framework on sizing systems, as it provided the background information for its development. Furthermore, the conceptual framework was designed in accordance with the objectives of the study. The concepts in the framework are interdependent and interact with one another, as each concept affects the usefulness of the other concepts. Hence in defining one concept, reference is made to the others.

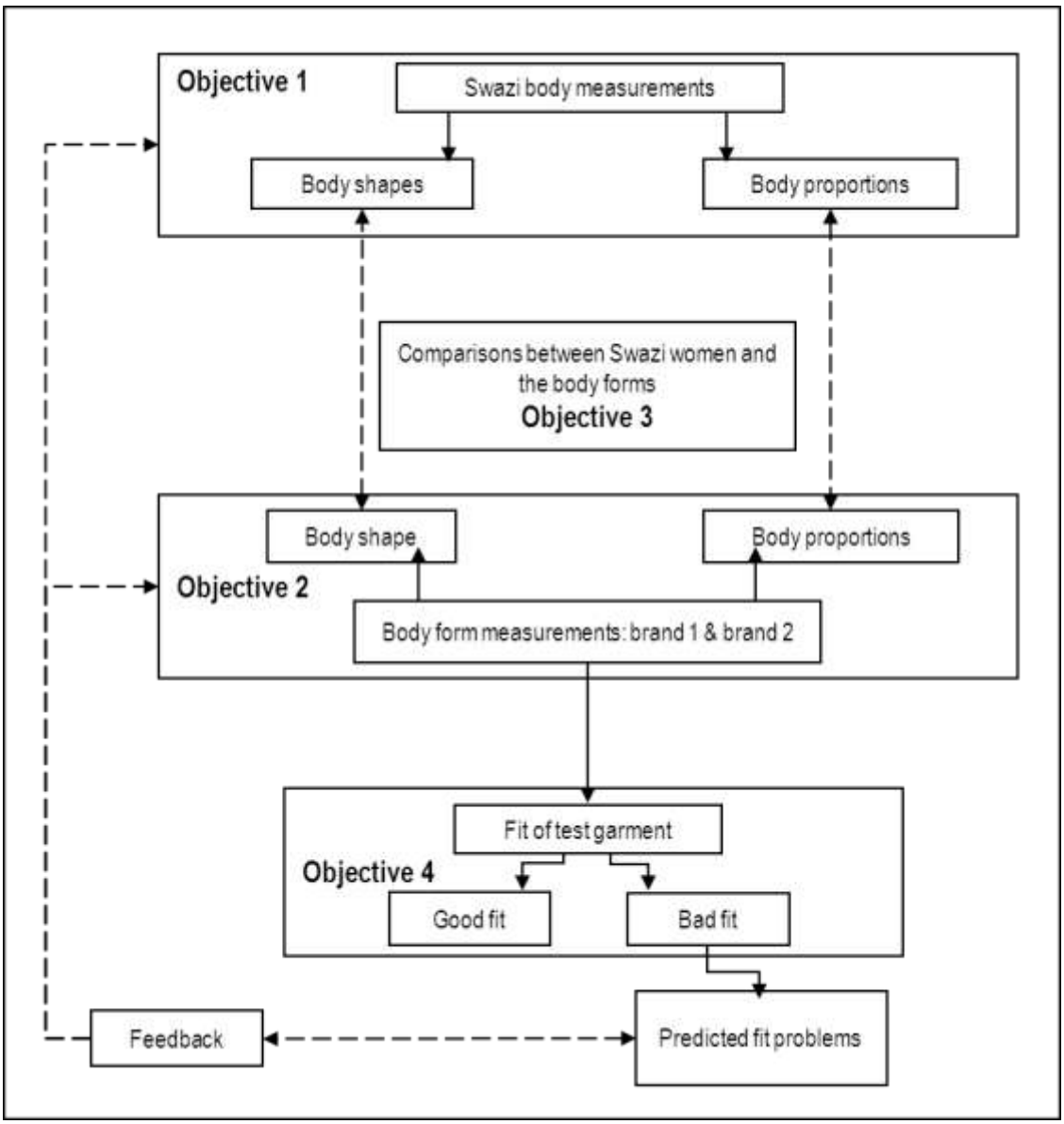


FIGURE 1.1: SCHEMATIC CONCEPTUAL FRAMEWORK FOR THE STUDY

Body measurements are critical in the identification of the body shapes and body proportions, while fit problems cannot be addressed without a set of accurate body measurements of the Swazi population (Istook & Hwang, 2001). In order to achieve good fit it is necessary to identify and define the size and shape based on a combination of key body measurements (Petrova & Ashdown, 2008). In an attempt to categorise body shapes, two main methods emerge: the use of proportions of the front and side profile widths (Connell *et al,* 2003) and the use of the proportions of body circumferences (Simmons, Istook & Devarajan, 2004a). To have the benefit of both methods, a combination of circumferential proportions, body heights and lengths and widths and depths were considered for this study. Although the circumferential measurements of the body forms and of the Swazi women may be similar, the shapes may be quite different and require differently shaped garments to

ensure good fit; thus there was a need to compare the two (Ashdown, 2003; Kwong, 2004:197).

Garment development is an iterative process based on pattern-making to resolve fit and production problems (McKinney, Bye & LaBat, 2012). The development of the pattern for the test garment was based on the measurements of the prevalent shape (triangular) of Swazi women. According to Ashdown (2003) and O' Connell (2006), fit testing is an important aspect of the product development process in order to achieve well-fitting garments. The resultant test garment facilitated fit testing on the body forms. The basic toile facilitated easy assessment of fit without camouflaging the shape and proportions of the body forms. The fit and comfort aspects have been shown to influence the satisfaction with garments (Griffey & Ashdown, 2006).

Perceived sources of fit problems are all rooted in the accuracy of anthropometric data. An inaccurate set of body measurements has repercussions that trickle down to all the other concepts in the framework and ultimately leads to fit problems. Feedback on fit problems experienced with garments made from body forms is helpful in addressing such problems.

1.3.2 Objectives of the study

Primary objective 1:

To identify and describe the most prevalent body shapes of young Swazi women through body dimensions.

Primary objective 2:

To identify and describe the body shapes of the currently used body forms through body dimensions.

Primary objective 3:

To describe and compare the most prevalent body measurements and proportions of young Swazi women to those of currently used body forms.

Sub-objective 3.1:

To analyse and compare the most prevalent body measurements and proportions of young Swazi women to those of currently used body forms (through measurements).

Sub-objective 3.2:

To investigate and determine whether there is a significant difference in body measurements and proportions of young Swazi women and currently used body forms.

Primary objective 4:

To test and evaluate the fit of the test garment which represents the size and most prevalent shape of the Swazi women, on the body forms.

1.3 SAMPLING PROCEDURE AND DATA COLLECTION METHOD

Due to time and financial constraints the data was collected from only one Faculty out of eight faculties at the University of Swaziland, i.e. the Faculty of Agriculture, and from one high school. The sampling frame, i.e. the total number of young Swazi women (female students aged 18 years – 30 years) currently at the Faculty of Agriculture, was three hundred and thirty one (331). In order to achieve a representative sample and reduce bias, a purposive non-probability sampling technique was employed for this study; thus the total population was identified using a non-random technique. A list of all the Swazi female students in the Faculty of Agriculture was sought from the Faculty tutor's office, and they were all approached and asked to indicate their bust sizes as it was one of the prerequisites for inclusion in the study. Out of all the young Swazi female students the total population of all those that indicated a bust size of 32 and 34 were studied to ensure that there were enough participants to provide statistically meaningful data.

In surveys, data collection is based on interactive social units such as social encounters, thus is much less compliant to probability sampling techniques. Convenience and availability by and large governed the data collection process. To reduce sampling error, a large sample of 101 women were measured and only one size 32 and one size 34 were measured for each body form brand because there can be no variation with regard to the shape and proportions.

For objectives 1 to 3, data was collected from two categories, i.e. young Swazi women (University students and one high school's students aged from 18 years to 30 years) and body forms (two brands). The total population of young Swazi women from the University and high school who satisfied the criteria stipulated for inclusion in the study, and from the two body form brands, i.e. a size 32 and a size 34, were included. The data was collected through anthropometrical techniques and recorded in data collection forms. For objective 4,

two test garments, i.e. size 32 and 34, were constructed using the body dimensions for the most prevalent (triangle) body shape of young Swazi women. Fit was evaluated using a 1 – 9 fit evaluation scale. The fit evaluation was done by three experts in the field of apparel design and construction, and recorded in fit assessment forms.

1.4 PRESENTATION AND STRUCTURE OF THE DISSERTATION

Chapter 2 is composed of the theoretical perspective and supporting literature review. Ashdown's (2000) model on sizing systems has been used as the theoretical framework, and four core concepts that are embraced by the model are clarified. Furthermore, relevant concepts associated with the phenomenon of the study are critically examined, i.e. the principles of fit, the body shapes established in different countries, commonly used body shapes, the role of body shape, proportion and size in fit, and fit problems associated with different body shape characteristics.

Chapter 3 presents the research methodology used for the study. It gives an account of the research strategy, approach, design and sampling plan that was used for the study. Furthermore it gives an exhaustive narration of the data collection techniques that were employed and a description of how the data was analysed. The latter part of this chapter is an explication of the efforts that were taken to ensure the quality of the data in terms of validity and reliability and how the ethical concerns were taken care of.

Chapter 4 presents the results and discussion of the research. All the objectives of the study are addressed, i.e. the results on the emerging distinctive body shapes and body proportions, comparisons in terms of body shapes and proportions between the Swazi women and the body forms, determination of significant differences and results on the evaluation of fit. Discussion, interpretations and implications of the results are also given.

Chapter 5 presents the conclusions drawn from the interpretations of the results of the study regarding the comparison of the body shapes of Swazi women and those of body forms currently used in apparel manufacturing. Some recommendations are made based on the findings.

CHAPTER 2
THEORETICAL PERSPECTIVE AND LITERATURE REVIEW

2.1 INTRODUCTION

The fundamental principles of the theoretical traditions are rooted in the development of inductive strategies of theory as opposed to logical deductions from assumptions. The concepts that are discussed are building blocks of the theory. They were created by e.g. various researchers through their experiences and observations resulting in their variation in perception. This translates to the conclusion of making assumptions; thus linkages emerge between concepts, assumptions and theories. A comprehension of the nature of the relationship of the relevant concepts, assumptions and theories prompted this scientific inquiry which translated to the formulation of the research objectives. For purposes of this study a group of concepts have been used as theoretical underpinning to drive the process of this inquiry. By understanding the nature of the relationship between the sizing and fit concepts and the systems theory, the researcher was able to provide explanations for fit problems that emanate due to shape variations and draw conclusions based on the systems theory.

2.2 SYSTEMS THEORY

The systems theory was used as a unifying framework in this study for Ashdown's theoretical framework on sizing systems. The assumptions of the systems theory were discussed in terms of the strictures of the study as reflected in the theoretical framework (**Figure 2.1**). A system is defined as a collection of interrelated parts or subsystems unified by design to obtain one or more objectives, i.e. the different aspects relating to sizing can be examined individually and their synergy in contributing to sizing and fit as a whole (Boss, Doherty, LaRossa, Schumm & Steinmetz, 1993:326; Heylighen & Joslyn, 1992). A system has a specific goal which determines the major parts thereof, i.e. input, transformation and output. The input of the system, i.e. the human, physical and operational resources required to accomplish the objectives, included the traditional anthropometry which was used as a means for data collection in this study. It required human resources, i.e. the skills, knowledge and energies of the measurer and assistant to yield satisfactory results with reduced error.

Physical resources included materials and facilities, i.e. the anthropometric equipment, land markers and the measuring room. Operational resources included money, time, utilities and information rendered to the subjects and authorities.

Transformation involves any action or activity used in changing input into output, such as activities involved in production and use of body forms. The anthropometric data obtained after the input stage was used during the transformation stage to identify body shapes and body proportions within the Swazi women population. The output, which is the level or quality of fit, represents the outcome from transforming the input, i.e. are the consumers satisfied or dissatisfied. It also represents achievement of the system's goals, namely customer satisfaction with regard to well-fitting garments (Boss *et al,* 1993:333).

A system is however not static, as it involves control, memory and feedback, i.e. it receives feedback from the environment leading to its parts or to the whole system adapting based on occurrences/experiences in the past and takes these experience from the system to guide future decisions/operations. To ensure that past mistakes are not repeated and to monitor trends, the anthropometric data used for existing body forms, the new anthropometric data from the Swazi women and data derived earlier from target populations as anthropometric data will be stored as memory. This data ought to be computed at ten-year cycles as the population's shapes do not remain static. This information can be used to compare data to determine or develop improved sizing systems and identify body shape/figures existent in the target population. The control element performs three functions in a system. It ensures that resources are used efficiently and effectively in accomplishing objectives, and provides standards for evaluation. The initial sampling plan proved to have loopholes that could be improved, as about 50% of the participants did not qualify to be part of the study. This had adverse repercussions as it resulted in inefficient and ineffective use of time and money. To rectify this flaw, the control element was used to ensure that the time and money resources were used efficiently and effectively as participants were then screened using retail under-bust measurements to qualify for inclusion into the study. Feedback includes those processes by which a system continually receives information from its internal and external environment, e.g. feedback from the textile apparel manufacturing industry that the body forms generally have poor fit. This valuable information has to be reflected back to the body measurements taken, methods used, expertise of the measurer, actual population measured and target population. The external environment includes consumers' complaints to retailers about ill-fitting garments for certain body figures (Boss *et al,* 1993:334-335). This information reflects back to ensure that the sizing systems are developed using anthropometric data derived from the target population and assists the system in adjusting to changes needed. Without effective feedback the system becomes a relatively closed system; thus the

permeable boundaries allow the system to be penetrated or affected by the changing external environment. The continuous response and adaptation of the system to its internal and external environment ensures a dynamic equilibrium (Boss *et al,* 1993; Heylighen *et al,* 1992). In order to remain viable, the sizing system used by the apparel industry has to be responsive to social and economic pressures and the opening up of international markets, and ensure a continual evaluation of the system which may lead to change.

Different countries have different sizing systems; however, they are all generally based on one key dimension that is used to define the sizes within the system (Workman, 1991:31-32). The basic principle of a sizing system is that it must be three-dimensional in structure by using the bust girth, waist girth and hip girth and stature as the main control measurements or indicators of shape differences. Hierarchy as an element of the systems theory makes these three measurements the most important compared to the other measurements. A sizing system plays a major role in fit as women use size labels to find out the size when they actually try on a garment. According to Istook and Hwang (2001), fit problems cannot be addressed without a set of accurate body measurements. Body measurements can be obtained by different methods, namely traditional tailor's measurements, traditional anthropometry and the use of the three-dimensional body scanners. The accuracy of the population's measurements may be influenced by the measuring methods used, equipment calibration and the measurer's skill or expertise. The measurer's skill or expertise may eliminate technical errors of measurement and the method of measurement may also influence the accuracy compared to traditional anthropometric equipment. The ultimate goal of each measuring method is to generate anthropometric data which embraces equifinality as the same output may be derived by different means. The systems approach focuses on the wholeness of a process rather than focusing on parts of the process. The output of the analysis of body shapes of Swazi women is not from population measurements only, but the comprehension and appreciation of the collective contribution of all the elements such as body measurements, shape and sizing system.

The concepts pertinent to the analysis of body shape to enhance fit are interdependent as each part affects the performance or effectiveness of the others. Their collective contribution towards fit demonstrates how they are intertwined and how a change in one would affect the others. For instance, a poorly skilled anthropometric measurer may cause technical errors in the data collected, hence the size charts, sizing system and the ultimate product (which is in this case body forms with fitting dimensions for the target population) is not valid or trustworthy, and ultimately the apparel produced using such body forms would cause customer dissatisfaction.

2.3 THEORETICAL FRAMEWORK

Ashdown's theoretical framework on sizing systems (**Figure 2.1**) is a useful framework for explaining the relationship between the sizing and fit concepts. It was therefore used as a point of reference for this study. The systems theory was however used as a unifying theoretical framework for this study. Support for Ashdown's theoretical framework in conducting this study stemmed from the ability of the systems theory framework to represent the interrelationship of concepts. Certain aspects of Ashdown's theoretical framework on sizing systems pertinent to the current study were used to guide the analysis of body shape and body proportions in improving the size and fit of body forms.

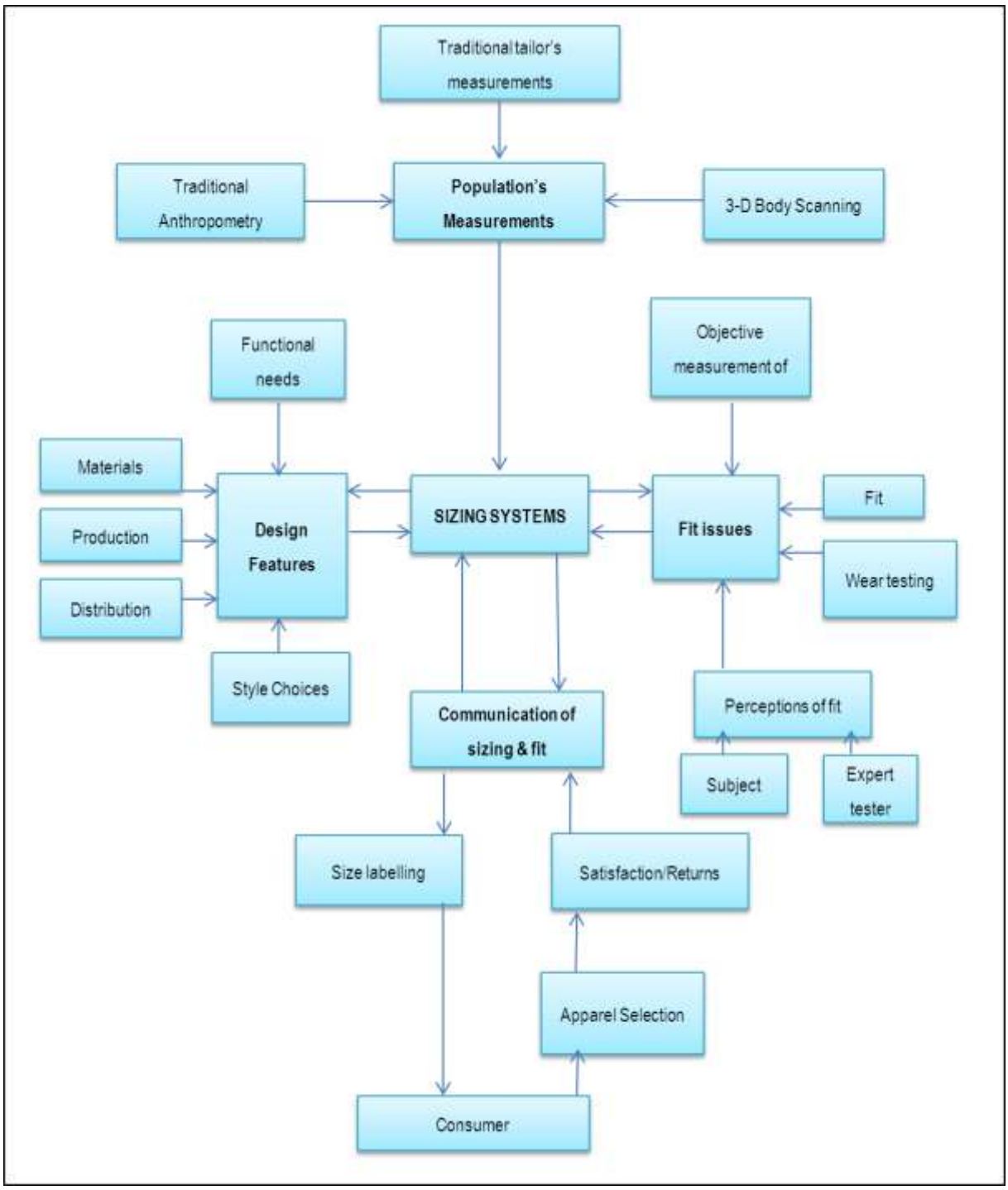


FIGURE 2.1: THEORETICAL FRAMEWORK (Source: Ashdown, 2007:xix)

Four major interrelated constructs form part of the complex theoretical framework on sizing systems, namely population measurements used as the basis, fit issues, design features and communication of sizing and fit (Ashdown, 2003). There are influential concepts converging from these core constructs that are further outlined by the framework. However, for purposes of this study, only those concepts that are pertinent to this study were examined.

2.3.1 Sizing systems

A sizing system is defined as a set of sizes derived by using common assumptions and methods of development. Size categories within a system are defined as the various groupings of sizes as reflected on ready-to-wear clothing size labels. Sizing systems generally use a base size, which is fitted to a fit model in the form of live models or body forms/mannequins, from which a set of sizes proportionately graded from this size, is generated (Ashdown, 2003; Gupta & Gangadhar, 2004). A sizing system may be expressed simply as small, medium or large or may be a complex system that provides a custom-fitted garment for each client. In her study, Ashdown (2003) noted that age, ethnicity and body type are crucial factors to be considered in the development of a sizing system.

Current sizing systems are based on the notion that the differences between sizes are measurable in equal linear incremental distances. According to Brunn (1983, in Mason, 2008), actual human sizes are not dependent on the assumption that incremental differences are constant. A sizing system serves to estimate limits in relation to variation in sizes and includes a range of sizes based on body measurement gradations of dimensions, a function that is not adequately addressed by existing sizing systems (Strydom & De Klerk, 2006). Crucial elements of a sizing system are: predetermined size ranges, specified size intervals, a standard method of size designation, and size labelling (Winks, 1997:25).

The definitive usefulness of any sizing system is highly dependent on the accuracy of anthropometric data within a specified allowable error per specific measurement; hence it is necessary to obtain current measurements of the targeted population. Anthropometric data can be used to determine both the range and the variation (difference in proportion) among people. Different countries have different sizing systems; however, they are all generally based on one key dimension that is used to define the sizes within the system (Workman, 1991:31-32). No single body measurement provides an adequate base for a sizing system because no single dimension is highly correlated with both the horizontal and vertical measurements (Patterson & Warden, 1984 in McRoberts, 2005). The present sizing systems assume an association between height and width, and do not incorporate the vast variation of figure types or body proportions in the population. There is no relationship based on statistical analysis of weight and height found to be the best overall indicators of horizontal and vertical body measurements (Holzman, 1996; Patterson & Warden, 1984, cited in McRoberts, 2005).

The basic principle of a sizing system is that it must be three-dimensional in structure by using the bust girth, waist girth and hip girth and stature as the main control measurements

or indicators of shape differences (Tamburrino, 1992a). This principle therefore hierarchically makes these three measurements the most important as compared to the other measurements. A sizing system plays a major role in fit as women use size labels to find out the size before they actually try on a garment. The sizing specifications which began in the 1940s still form the basis of today's standards. As mentioned above, the sizing specifications were developed to reflect incremental changes in body measurements but not variations in body shapes; as a consequence women's apparel sizing continues to reflect one body shape, i.e. an hourglass. The hourglass body shape was regarded as proportionate given the fact that at the time the size charts were developed, women wore girdles and other body shaping apparel. Nowadays women generally do not manipulate their body shapes by wearing body shaping apparel hence their body shape is as it is (McRoberts, 2005).

General failures in the current sizing systems are in part due to the dependence upon outdated anthropometric data collected in the 1940s (Magagula & Zwane, 2006; Mlauli, 2004:40; McRoberts, 2005). Other existing shortcomings in the sizing systems include: inconsistent labelling of sizes, absence of measurements on hang-tags, and inadequate size ranges for current body type variations (Ashdown, 1998). Consumers have to try on many sizes to overcome variations, keeping in mind that as apparel becomes less expensive the actual dimensions of the garment are smaller (LaBat & DeLong 1990; Goldsberry, Shim & Reich, 1996; Tyragiel, 2001). The effectiveness of a sizing system is highly dependent on the skill of individual pattern makers and graders and the amount of effort a company puts into defining and producing the type of fit appropriate for its own target market (Ashdown, 2003). An optimal sizing system selects size groupings that will fit the majority of the population in a limited range of sizes.

2.3.2 Population measurements

Population measurements are vital for the identification of body shapes as fit problems cannot be addressed without a set of accurate body measurements (Istook & Hwang, 2001). Body measurements can be obtained by different methods, i.e. traditional tailor's measurements, traditional anthropometry and the use of 3-D body scanners (Johnston, 1994). Anthropometry is defined as the measurement of the human body with a view to determine its average dimensions, and the proportion of its parts, at different ages and in different races or classes (Oxford Dictionary, 1989). It is a science of measuring the body that takes into account body build components such as surface body measurements. In Swaziland, current sizing standards are based on body measurement data that was gathered in Britain in the 1940s (Magagula & Zwane, 2006). There has been no comprehensive

anthropometric study of today's population undertaken in Swaziland; yet apparel has to fit today's population.

Anthropometric techniques are used to measure the absolute and relative variability in the size and shape of the human body. Anthropometry follows a rigorous set of guideline that includes the standardisation of the measurement techniques, uniform landmarking and establishing conditions for taking the measurements (Johnston, 1994; Beazley, 1996). Various references have been developed that can be used for expressing absolute and relative deviation from the average. Techniques for analysis include for example the expression of individual values in the form of Z scores (i.e. the individual value minus the reference mean for age and sex, divided by the corresponding standard deviation). The accuracy of the population's measurements may be influenced by the measuring methods used, equipment calibration and the measurer's skill or expertise. The measurer's proven skill or expertise may eliminate technical errors of measurement to ensure accuracy. In addition to accuracy, it is important that anthropometric data is current and representative of the population being measured. To control error that may be caused by outdated anthropometric data no longer depicting body shape variation of a specific population, Brunn (1983, in Mason, 2008) suggests that they be taken at ten-year intervals. Anthropometric studies are expensive and time consuming to conduct; therefore representative samples of the entire population can be taken considering crucial factors such as age, ethnicity and body type. Relationships among different measurements of human body size, e.g. bust, waist, and hips, can be interpreted as indicators of shape differences; thus body measurements can be related to body shape.

Traditional anthropometry employs anthropometric methods and tools to ensure the generation of valid and reliable measurements. Anthropometric tools include an anthropometer which is used to measure straight linear distances, callipers used to measure linear depths and widths, a segmometer which is used to measure segmental lengths and projected heights from a measuring box, and calibrated measuring tapes. It is worth noting that the segmometer is a less expensive, accurate alternative for the anthropometer (Johnston, 1994:19). Accuracy is amongst other factors dependent on the person taking the measurements. As is often the case with traditional tailor's measurements, the most common sources of error with anthropometric methods include incorrect instrument use, subject positioning, and ambiguity in landmark location. A landmark is a point on an object that matches between groups or within a population, and aids in visual shape analysis. Proper training of the measurer and assistant can ensure accuracy and consistency of results. It is often advised that two persons each measure a subject to enhance accuracy (Workman, 1991:32).

Determining complete and accurate anthropometrical measurements is not easy. Traditional manual and technologically advanced methods have however been developed and used over the years. Traditional tailor's measurements refer to measurements taken along the contours of the body using a measuring tape ("contour" refers to the curves of the body). The accuracy of this method can be considerably reduced due to posture shifts by the person being measured and variation in identifying landmarks and placement of the measuring tape. A skilled tailor can however take very accurate measurements, but the measurements and methods may still vary among different professionals (Ashdown, 2003). However, it is of paramount importance to establish where and how measurements are to be taken on the body, thus ensuring that pertinent measurements are taken. Key dimensions are crucial for the depiction of body size and shape to ensure well-fitting garments to the wearer. To ensure good fit, key dimensions should be measured on the human body in a standardised manner at appropriate established landmarks on the human body (Beazley, 1996).

There are substantial benefits in measuring the human body using body scanners, compared to traditional anthropometry and traditional tailor's measurements. 3-D body scanners are less invasive as they allow the measuring of the human body without physical contact. Furthermore the possibility of unreliable, unacceptable and invasive measurement procedures and inaccurate judgements of posture are eliminated. Accurate body measurements are yielded as the observer error characteristic of traditional methods is eliminated (Apeagyei, 2010). There are however issues with the precise location of body landmarks in both approaches. With regard to traditional manual methods, due to the awkward location of some measurement areas (e.g. the crotch for the inside leg measurement), the precise placement of body landmarks can be based on the personal opinion of the measurer (Beazley, 1996; Apeagyei, 2010). There are also ethical issues to be taken into consideration e.g. garments worn during the measuring process that have to be laundered before the next participant can use them and the idea of wearing undergarments, which may be quite invasive.

The main types of 3-D body scanning technology are the laser and light devices that capture the surface of the human body to extract body measurements without physical contact with the body. The laser scanners work on the basis of a light plane and triangulation method whereby a laser is used as a light source and a coupled charge device (CCD) scans the field of view and detects the displacement of the light on the body. Light scanners project a series of white light stripes on to the subject and are captured through cameras. The 3-D shape of the body is then described through the curve of the stripes over the subject. Structured light scanning is widely used in the clothing industry as it is less expensive compared to the laser scanners (Apeagyei, 2010; Yu, 2004b:148).

2.3.3 Fit issues

Fit is a complex phenomenon, and has many varied interpretations. Fabric properties, 3-D body shape, clothing physical dimensions, socio-psychological perceptions of the wearer such as fashion and body cathexis all play a role in interpreting proper fit (Yu, 2004a:33; Ashdown, 2003). Fit issues continue to be a growing concern to consumers as they are not happy with clothing that does not provide a good and desirable fit (LaBat & Delong, 1990; Goldsberry *et al,* 1996). Despite the varied interpretations, fit is highly dependent on the human proportions. Fit is therefore directly related to the anatomy of the human body, and most of the fitting problems are created by the bulges of the human body (Yu, 2004a:31). Fit may be defined as the manner in which clothes conform to the body (Ashdown & Delong, 1995, cited by Tselepis & De Klerk, 2004:88). Clothing fit ought to afford the wearer comfort with enough ease for movement and for the expression of a given fashion style (Amaden-Crawford, 2006). The definition of good fit is a complex issue confused by the lack of conformity among the different stakeholders involved in the process, yet consumers still generally use fit as the foremost measure for clothing appearance. However, as fashion changes, so do the acceptable standards of fit (Yu, 2004a).

The fit and determination of levels of satisfaction with the features of ready-to-wear garments are of importance to enhance sales and cut down on returns due to poor fit (LaBat & DeLong, 1990). Dissatisfaction with fit is one of the most frequently stated problems with garment purchases (Salmon, 2000, cited in Alexander, Connell & Ulrich, 2005). In order to achieve good fit among other things, manufacturers ought to consider body measurements, ease, proportions and body shape. To fit each consumer therefore, firstly each manufacturer must successfully interpret body measurements and produce apparel that satisfies consumers' fit preferences, though fit preference is very subjective and varies from person to person (Fan, 2004). Understanding the fit preferences of consumers yields satisfactory fitting apparel, as psychological factors related to body shape and size have an influence on one's perception of size and fit (Simmons, 2002). Secondly, manufacturers should consider ease, which may be evaluated in terms of excess, enough or lack of ease. Excess ease results in long shoulder seams, folds or gapping across the chest into the armhole or neckline, whereas lack of ease results in pulling or tightness across the bust, shoulder blade level or waistline and pulling or twisting of the side seams. Manufactures should understand fit beyond the notion of body measurements but also from the consumer's perspective (Anderson, Brannon, Ulrich, Presley, Woronka, Grasso & Stevenson, 2001; McRoberts, 2005:14).

Ashdown and DeLong (1995) noted two issues which consumers address relative to a perception of fit, i.e. personal judgement on how the garment looks on the body and perception of the level of comfort based on physical and visual responses from the consumer. Given the difficulty of fit testing and the development of more objective fit evaluation techniques, there is still a major dependency on subjective assessments of garment fit using expert panels and fit models (Ashdown. 2003; Yu, 2004a:38). Fit has to take into consideration the utility and aesthetic value of clothing items and the different body shapes and sizes that exist within a population. Amongst other things therefore, the evaluation of fit depends on the end use of the apparel item and the shopper profile, e.g. when shopping for children's wear or functional garments fit is significantly related to the perceptions of product quality, durability and performance. Body shape analysis is also of essence, as it is the theoretical foundation for the development of apparel that will fit well.

In conclusion, studies of sizing systems indicate inconsistencies ranging from deceitful size manipulation, whereby some manufacturers steadily increase dimensions without changing size labels, resulting in vanity sizing. Voluntary sizing systems compound the problems because without mandatory standards in place, designers create sizing systems based on target markets, thus rendering the numbering systems meaningless as each system offers a different fit (Ashdown, 1998; Anderson *et al,* 2001). In some countries (e.g. the USA) there are standards; however manufactures still prefer the leeway of changing measurements to suit their consumer needs without referring to the standards and moreover do not share them with stakeholders (Yu, 2004c:184). This practice is an indication that there is a problem with sizing systems that are not standardised, hence a variability within sizing systems will be existent for a while to come.

2.4 LITERATURE REVIEW

The key concepts contained in the literature review constitute the schematic conceptual framework and are rooted in the theoretical background.

2.4.1 Elements of fit

The elements of fit, i.e. garment ease/comfort, fabric grain, garment set, line and balance, form the basis of the criteria for evaluation during fit sessions. Different as they may be, the elements of fit are highly interrelated, as an effect on one element impacts on the other elements. Fit is an important criterion in a consumer's evaluation of an apparel product,

therefore fit sessions at product development stage are vital because they directly translate to consumer satisfaction or dissatisfaction with the apparel product. Manufacturers that maximise the potential of their fit sessions can produce better fitting apparel. However, due to a wide variation in body shapes and sizes, fit problems continue to be an issue for apparel manufacturers and retailers alike. It is therefore essential to evaluate the fit based on the elements of fit, comfort and appearance on a fit model or body form. Human fit models, unlike body forms, may vary in their measurements and may not be perfectly symmetrical (Bye & LaBat, 2005). In addition to the evaluation of fit, the evaluation of the design is also of importance.

How a garment appears and feels on a human body or body form is determined by the wearer and fit experts based on ease and comfort. Fit experts take into account style specifications and the elements of fit (Brown & Rice, 2001). The five elements of fit are highly interrelated; they serve to describe different but related aspects of fit. For example, a garment with inadequate ease will, when worn, have poor set and distorted grain. If a garment is off-grain, it is also out of line and out of balance. Fit evaluation that is conducted by experts is believed to be objective and thus yields more reliable and valid data (Bougourd, 2007). Trained fit evaluators follow criteria to analyse fit jointly or independently. When the rating of fit is done independently by the evaluators, the average scores of members are calculated. However, if done jointly, the evaluators may discuss and decide on the rating to give on the scale in order to reach an agreement. Summaries of the elements of fit compiled from Brown and Rice (2001) are presented below.

2.4.1.1 Fabric grain

As an element of fit, grain refers to the need for lengthwise yarns to run parallel to the length of the body at the centre front and centre back, while the crosswise yarns run perpendicular to the length of the body at the bust and hip levels. Consideration of the orientation of the warp and weft yarns in a fabric is vital for a garment to exhibit good fit and interpret the intended style. An on-grain garment must be cut and sewn on grain to ensure that it hangs evenly on the body and appears symmetrical. If the opposite is true, the garment will not hang straight. Abnormalities in grain line orientation may occur when the garment was not cut or sewn on grain. Poor posture or figure abnormalities of the wearer may also affect the hang of the garment on the human body. An allowance to the breaking of the grain rule is when a garment is cut on the bias, with the bias of the fabric placed parallel to the length of the body to create different effects (Brown & Rice, 2001).

2.4.1.2 Garment set

Set refers to a smooth and even fit without inappropriate wrinkles, i.e. a well-fitted garment rests on the figure smoothly without any undesirable wrinkles. Wrinkles on a garment that are a result of poor set cannot be removed by ironing the garment as they appear as a result of the way the garment fits the wearer. Set wrinkles may occur if the garment is too large or too small, and the fabric pulls or sags where the garment does not fit properly. Sometimes, poor set may be the result of the wearer's poor posture, which can be corrected with improved posture, which improves the body curves and hollows that interfere with good set. The type of wrinkles and their location determine the cause of the fit problem if a garment has poor set.

2.4.1.3 Line

Line refers to the alignment of the structural lines of the garment with the natural lines of the body. For example, side seams should hang straight like a plumb line down the centre of the side of the body, perpendicular to the floor, i.e. the side seams should appear to divide the body in half when viewed from the side. Centre front and centre back lines should likewise fall straight down the centre front and centre back of the body. Curved seams such as necklines, armholes, waistlines, and hemlines should be gradually curved lines that follow the circular lines of the body part they are intended to fit. Figure irregularities and variations can distort the lines of the garment, while poor construction can result in an out-of-line garment.

2.4.1.4 Balance

Balance is linked to the elements of grain and line. It occurs when the garment is in equilibrium, i.e. the garment hangs evenly on all sides of the body unless the design dictates otherwise. The right and left parts of the garment appear evenly balanced, or symmetrical, when viewed from the front, back, or sides. A skirt is balanced, e.g. if the legs are in the middle of the skirt and not touching the front or back of the skirt. Garments are said to be off-balance if they are cut off grain, causing them to hang unevenly or, if the lines of a garment do not follow the lines of the body, the garment will hang out of balance. Poor posture and/or a lack of symmetry in the wearer's figure are likely causes of balance problems. Poor apparel construction techniques may also result in an unbalanced garment.

2.4.1.5 Garment ease

Ease refers to the difference between the measurements of the garment and the measurements of the body of the intended wearer. There are two types of ease: fitting ease and design ease. The measurement of a garment should equal the measurement of the wearer's body plus fitting ease, plus design ease or style fullness, if any. The garment must allow the wearer to comfortably move with ease without any sagging resulting. The amount of ease is determined by the style of the garment, fabric to be used, current fashion, size and the intended use of the garment.

2.5 THE ROLE OF BODY SHAPE, PROPORTIONS AND SIZE IN FIT

Body shape analysis is the basic theoretical foundation for the development of apparel sizing that will fit well. Regardless of the sizing systems used, almost all are based on the myth that humans have mathematically proportional bodies and that they grow in proportional ways. There are times in most persons' lives that this is relatively true, e.g. from birth to the age of about 15, the American population as a whole, for example, tends to grow taller as it grows bigger around the waist (Winks, 1997; Ashdown, 2003; Pisut & Connell, 2007). It should be noted however that the shapes and proportions of today's population differ greatly from the shapes of the previous generations. Body shape is a crucial element in apparel fit as the body is viewed as a three-dimensional structure, i.e. it has height, width and depth, expressed in terms of shape, proportions, postures and contours. The classification of female body shape is a challenging problem because there is variability within and between human forms as well as variability across time (Shin & Istook, 2007). Swazi women are generally found to be of different body shapes. Four figure types were categorically identified within the population studied, with the most prevalent being the triangular/pear/bottom-heavy shape (Magagula & Zwane, 2006).

Biederman's and Mossiman's theories are applicable to the analysis of the human body shape. Biederman (1985) proposed the recognition by components theory for understanding human image. He mentioned that, when an object is viewed, its image is segmented into volumetric shapes (e.g. blocks, cylinders, wedges and cones) at points of deep concavity and at cusps where there are discontinuities in curvature. He recommended distinguishing size gradation in describing object's shape components. Mossiman (1988) was adamant that size was not related to shape, pointing out that shape should be used for classification and hence could be used to classify organisms within small or large species. This theory

therefore suggests that persons who wear a specific size category cannot all be assumed to be the same shape and that persons who range from small to large or short to tall within the apparel size category may have similar or different shapes. This is illustrated in (**Figure 2.2**) below, showing a body scan illustrating body variation within size 10 pants sizes.

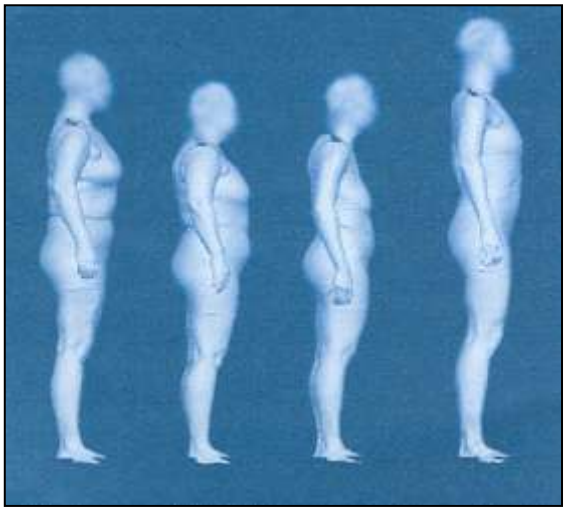


FIGURE 2.2: VARIATION WITHIN SIZE 10 PANTS SIZE (Source: Ashdown, 2003)

The female body shape has a bearing on a wide range of human activities, and there have been widely different ideals of it in different cultures through history (Fan, 2004:5). The female figure is usually narrower at the waist than at the chest and hips, unless there is a high proportion of body fat distributed around the waist. The chest, waist and hips are referred to as inflection points, and the ratios of their circumferences define their basic shapes, i.e. banana, apple, pear or hourglass. Body shape depends on skeletal structure and the distribution of fat in the body. The female body usually inflects inwards towards the waist around the middle of the abdomen. How much the chest or hips inflect inward towards the waist determines the structural shape. The degree of inflection depends on weight, muscle tone, pattern of weight distribution and posture. A woman's dimensions are often presented by the circumference around these three inflection points.

2.5.1 Commonly used and established body shapes

Attempts to classify body shapes into similar types in order to establish size standards, have resulted in the formation of several size groupings. Female body shape has a bearing on a wide range of human activities, and there have been widely different ideals of it in different cultures through history. From the delineation above, it is evident that there are established body types that bear similar shape characteristics which have been grouped by different scholars and authors based on their observations and views. The descriptions of the

commonly established body shapes are based on the shoulder-hip relationship and are presented in **Figures 2.3, 2.4, 2.5, 2.6, 2.7, 2.8 and 2.9.** Independent of fat percentage, weight or width, most female bodies have one of the elementary geometries, ordered by their commonality in society (Rasband, 1994:14-15). It should be noted however that not everybody conforms exactly to one particular type. Some women have a variation or two that is atypical. The figure types commonly used as frames of reference are the following shapes: triangular, inverted triangular, rectangular, hourglass, diamond-shape, tubular, rounded shape, and the ideal shape. The spoon shape is found within the American population, which is characterised by a greater circumferential difference between the hip and bust, a greater hip-to-waist ratio, and a lower bust-to-waist ratio compared to an hourglass shape (Devarajan & Istook, 2004; Simmons *et al,* 2004a). However, this figure type was found not to exist within the Kenyan population (Mason, 2008). Geometric shapes are normally used as visual cues to identify the general figure type. Although circumferential measurements of the bust, waist and hips may be the same, the shapes of figures may be quite different, hence would require differently shaped garments to get an accurate fit (Kwong, 2004:197). The discussion below on the different body shapes are summaries based on literature on this topic by: Rasband (1994:12-13); Armstrong (1995); Rasband and Liechty (2006:23-29); Magagula and Zwane (2006); Connell, Ulrich, Brannon, Alexander & Presley, (2006); Lee, Istook, Nam and Park (2007).

2.5.1.1 Ideal body shape

The *ideal* figure type is used in pattern and clothing design, it is symmetrical as it is similar in width in the shoulders and hips, with medium bust, small waist that is about 25 cm smaller than the hips, with a flat to slightly curved abdomen, moderately curved buttocks, slim thighs, and an upright posture. The figure is well-balanced with no exaggerated area, hence aesthetically pleasing body proportions. There is enough weight to cover the bones and hollows of the body softly and smoothly. Not all women fall within this body type, though most apparel is manufactured based on this body type, hence the fit problems due to a variation in figure types. Armstrong (1995:30) describes the ideal figure as elusive as it is considered ideal when its dimensions satisfy a majority of consumers and because its silhouette and set of measurements change at the slightest impulse of fashion. The ideal figure type is sometimes confused with the hourglass body shape; yet other authors such as Rasband & Liechty (2006) note a difference between the two as the ideal shape is said to be perfectly proportioned, while the hourglass has a proportionally very small waistline. Though the ideal shape is said to be elusive, there is some agreement that it does have standards to guide its silhouette, though the standards are not universal due to the variability of body shapes within

and amongst ethnic groups. Therefore, different countries have their own defined concept of an ideal figure.

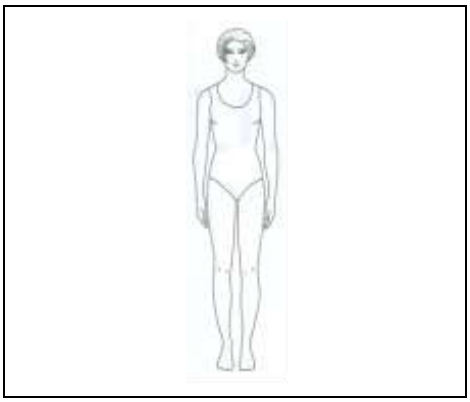


FIGURE 2.3: IDEAL BODY SHAPE

2.5.1.2 Hourglass body shape

The hourglass body shape appears equally wide and smoothly rounded in the bust area and the hip area. The bust and hip areas are of almost equal size, but the waist is proportionally very small compared to the hip area. The bust is medium to large, while the midriff and upper hips taper to a small, well-indented waist. The hourglass figure is balanced top and bottom as the bust and hip circumferences measure the same or similar. This figure type has a very small waist in proportion to the hip and bust, as the waist circumference is smaller by 27.5 cm or more. Weight gain is fairly evenly distributed above and below the waist and even with extra weight, the waist remains proportionately smaller. As the body fat percentage increases, the arms, chest, hips and rear are enlarged before other body parts such as the waist and upper abdomen (Rasband & Liechty, 2006:24-25).

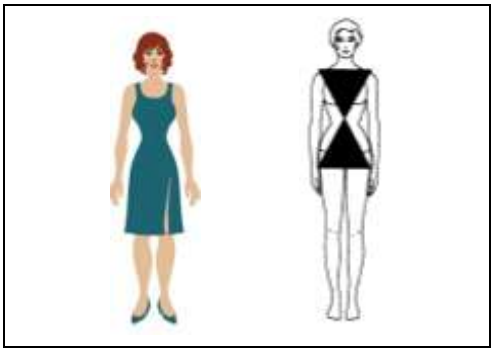


FIGURE 2.4: HOURGLASS BODY SHAPE

2.5.1.3 Triangular body shape

The triangular body shape is also referred to as the pear, bell or bottom-heavy body shape. It appears to be smaller or narrower above the waist, with narrow shoulders and upper back, and larger or wider below the waist. Bones are usually small but well-padded below the waist, with weight concentrated in the buttocks, low hips and thighs. The figure appears unbalanced, seen top to bottom, as it has a dominant low hip or side thigh curve, with a hip circumference that measures 5 cm larger or more than the bust circumference. The bust is small to medium and the waist is also small to medium. The buttocks and hips are rounded, with a low hip curve, and the upper thighs are usually heavier. Extra weight goes on the lower torso first. Fat distribution varies as it tends to be deposited first in the buttocks, hips and thighs. However, as the body fat percentage increases an increasing proportion of body fat is distributed around the waist and upper abdomen. Women with this body type tend to have a relatively larger rear, robust thighs and a smaller bosom.

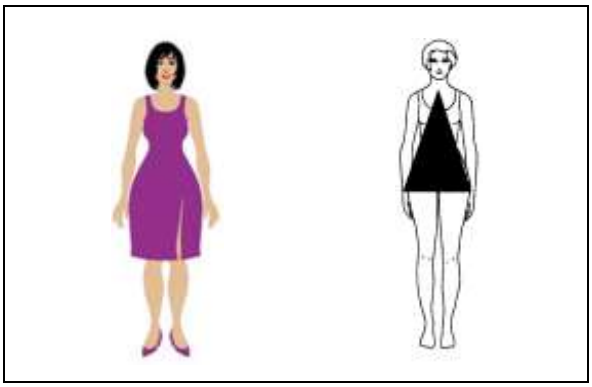


FIGURE 2.5: TRIANGULAR BODY SHAPE

2.5.1.4 Inverted triangular body shape

The inverted triangular figure, which is also referred to as the apple, appears larger or wider above the waist and smaller or narrower below the waist. Bones are usually medium in size and weight is concentrated in the shoulders, upper back and/or bust. The figure appears unbalanced as the shoulder area is comparatively wider than the hip area and the bust is medium to large. The midriff is usually shorter and the waist is medium to wide. In proportion to the wide shoulders and narrow hips, the legs are longer with straight and thin thighs. It has a high hip curve with narrow square hips and small or flat buttocks. The bust measures 2.5 cm more than the hip circumference, and extra weight goes to the high hip and distributes to the upper torso.

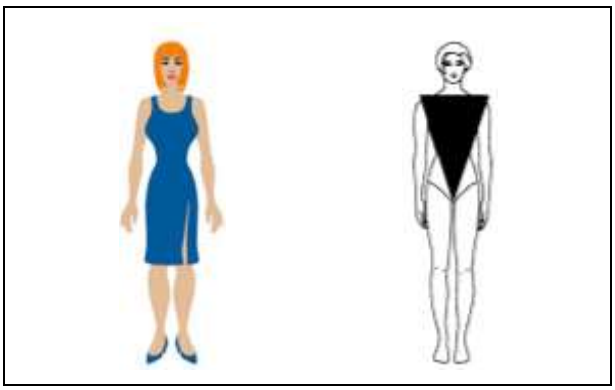


FIGURE 2.6: INVERTED TRIANGULAR BODY SHAPE

2.5.1.5 Rectangular body shape

The rectangular body shape is also referred to as the tubular, banana or straight shape. This body shape appears to be nearly the same width at the shoulders, waist and hips – nearly straight up and down. The figure has no waist definition as the waist is slightly indented, i.e. tapers very slightly at the sides and appears to be wide in proportion to the hips area. Side thighs are generally the same width as hips. The bust is small to medium and the waist circumference measures 17.5 cm or less than the bust or hip circumference. Extra weight gain tends to be fairly evenly distributed over the body. The weight is usually evenly distributed over the body around the waist area, making the waist indentation not easily visible. This may be attributed to the fact that the body has a relatively high androgen level compared to the oestrogen level, which causes the skeleton to develop towards a more masculine pattern and the body fat to be distributed predominantly in the abdomen, buttocks, chest and face areas. This fat distribution pattern creates the typical straight shape. The rectangular body shape is referred to as tubular when thinner, because weight is considerably below the average range. The tubular shape is characterised by comparatively narrow shoulders and hips, small bust, waist and buttocks, thin arms and legs – simply because there is very little flesh to distribute over the bones of the body.

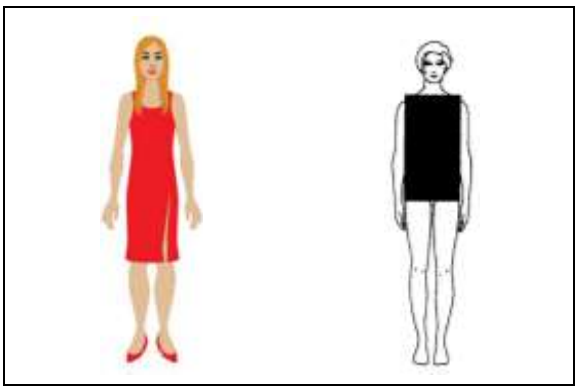


FIGURE 2.7: RECTANGULAR BODY SHAPE

2.5.1.6 Diamond-shaped figure

The diamond-shaped figure type is symbolised by narrow shoulders and hips in combination with a wide midriff and waist. The midriff and upper hips do not taper inward toward the waist, but appear to expand outward at the waist. The bust is often small, with a high hip curve and straight or inwardly tapered side thighs. The buttocks are often smaller and legs are proportionately thinner. Weight is concentrated in the midriff, waist and abdomen area. The waist or mid-body circumference is often wider than that of the hips and bust. This figure type is not common.

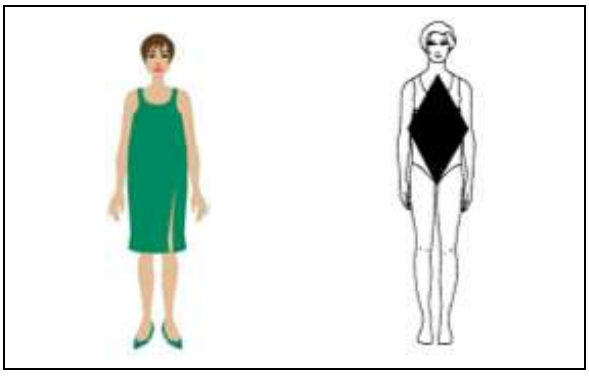


FIGURE 2.8: DIAMOND BODY SHAPE

2.5.1.7 Rounded body shape

The rounded figure type is also referred to as the oval figure type. It has full-rounded body areas all over and has weight that is conspicuously above the average range, usually concentrated around the chest and belly. The upper back and upper arms, bust, midriff, waist, abdomen, buttocks, hips and upper legs are larger and rounded. This figure is

ballooned by excess weight, as weight reduction into an ideal weight range would make this figure look more like one of the other figure types.

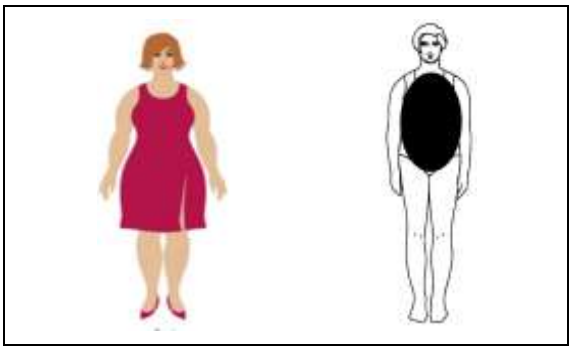


FIGURE 2.9: ROUNDED BODY SHAPE

2.5.2 Established body shape classifications in other countries

When creating sizing systems, different countries have different definitions of body types, based on body dimensions such as height and ratios between body measurements or the drop values, i.e. the differences between the key body circumference measurements. However, almost all the countries use height as a descriptor for the different body types, after which the different height categories are further classified according to e.g. the bust measurements, hip measurements, body build or drop values. In the United States for example, figure types are classified as junior petite, junior, misses petite, misses, misses tall and women, whilst in Canada and Czechoslovakia there are only three body types, namely junior, misses and women and figures type A, B and C respectively. ISO has three body types too, namely A, M and H, which are defined according to height and drop values. The Hungarian and Austrian sizing systems define only two body types, i.e. normal and full, and short and normal, respectively. The Netherlands and Germany have defined nine figure types based on three height categories that are further classified into three groups each depending on hip size. Korea has five figure types and uses only height to define the figure types (Yu, 2004c:186).

2.5.2.1 Classification of body shapes in the USA

The body types used in the USA sizing system are classified based on body proportions, with age and height as influencing factors. The first sizing standard in the USA was the commercial standard CS 215-58 and the size categories for women included misses, juniors, women and half-sizes. This standard was however used on a voluntary basis by the apparel industry. The CS 215-58 sizing standard was followed by the PS 42-70 sizing standard,

which had additional anthropometric data; however, both standards assumed that the female body has no variation but is proportional, and this resulted in a sizing system whereby the sizes had a linear relationship (Ashdown, 1998). These standards were later on considered no longer relevant to the current population; thus a new standard was developed. The new standard sought to reflect the substantial changes in the current population (Workman & Lentz, 2000; Yu, 2004b:186). The numerical size labels in the current standard have no link with the body measurements, which would have helped the consumer when purchasing. As a consequence, according to Ashdown (1998), apparel manufacturers use the same size designations for clothing that fits differently sized women; thus, women have to try on garments before a purchase as the size label does not guide the consumer in terms of actual body measurements. New voluntary standards were then developed and the established commonly used body type categories have sizes ranging from small to large. The body type categories for women are the junior petite, misses petite, misses, full-figured women, half-size women and plus-size women (Amaden-Crawford, 2006:38; Knowles, 2005:32).

Junior petite: This figure type has a small frame, shorter torso, small proportions and less mature development than the misses' categories, and is usually composed of young adults. It is targeted at women with a height range of 4'11" to 5'3" and odd numbers are used for the sizes in this category.

Misses petite: This figure type is slightly heavier and more fully developed compared to the junior petite. It is shorter and has narrow shoulders, a higher bust and a thicker or wider waist. It is targeted at women with a height range of 4'11" to 5'3" and even numbers are used for the sizes in this category.

Misses: This category is targeted at women with a height range of 5'4" to 5'9". It is fully developed, has a well-proportioned figure, a longer waist length, fuller bust and hips, and is generally quite slim.

Full-figured women: This figure type has the same proportions as the misses figure type, but with a thicker and heavier waist and bust. It is targeted at women with a height range of 5'4" to 5'9".

Half-size women: This category usually comprises women who have gone through menopause and is targeted at women with a height range of 5' to 5'6". It is more mature, has a short waist and is generally a shorter and heavier body type.

Plus-size women: This category is aimed at a full-figured woman with rounded shoulders, average shoulder width, fuller stomach, larger biceps and larger bust cup. It is further categorised into three figure types, i.e. the apple, rubenesque and pear. The apple has an aligned bust and hip, while for the rubenesque figure the hips are 10" larger than the bust. The pear shape has hips that measure 12"+ larger than the bust. All three these shapes have lost a well-defined or shapely waistline.

2.5.2.2 Classification of body shapes in Korea

The Korean body types used in the Korean sizing system were suggested based on the ISO sizing system in 1998, which was later improved in 2004. Three basic body types are recognised by the Korean sizing system for the upper body and lower body. The upper body can be classified into an A, H, or N type, depending on the difference between the hip circumference and the bust circumference. The lower body can also be classified into three types, i.e. an average, small waist and a large waist type, whereby the difference between the hip circumference and the waist circumference is the criterion for classification (Lee, Istook, Nam & Park, 2007).

Upper body classifications:

Type A: has a small bust and large hips, with a difference between the hips and bust ranging from 9 – 21 cm.

Type H: has a large bust and hips and the difference between the hips and the bust ranges from 14 cm to -3 cm.

Type N: is the average type with a difference between the hip and bust ranging from 3 to 9 cm.

Lower body classifications:

Average type: has a difference between the hip and waist circumferences that ranges from 14 to 22 cm.

Small waist type: has a difference between the hip and waist circumferences ranging from 22 to 38 cm.

Large waist type: the difference between the hip and waist circumferences ranges from -4 cm to -14 cm.

2.5.2.3 Classification of body shapes in the UK

In the United kingdom (UK), there are three body types that are defined by height and bust development (Mason, 2008).

Height categories:

Short: refers to a body shape with a height less than 155 cm.

Average: refers to a body shape with a height of between 155 cm and 162.5 cm.

Tall: refers to a body shape with a height of 165 cm and over.

Bust types (Kemsley, 1957:14, in Mason, 2008):

Extra large bust: Body shape with bust measuring 4" more than the hips;

Large bust: Body shape with bust measuring 2" more than the hips;

Full bust: Body shape with bust measuring the same as the hips;

Medium bust: Body shape with bust measuring 2" less than hips;

Small bust: Body shape with bust measuring 4" less than hips;

Very small bust: Body shape with bust measuring 6" less than hips.

2.5.2.4 Classification of body shapes in Canada

In Canada, the sizing standard, i.e. CAN/CGBS-49.203-M87, states that apparel items should have a size label showing the applicable size indicator, body measurements and/or the size code at the point of sale to guide consumers in choosing the right sizes. Adhesion to standards is however voluntary, thus actual sizes labelled on standard sizes may still differ from one manufacturer to the next (Faust, Carrier & Baptist, 2006). There is room for great variation in size identification as the standard sizes labels are not authentic due to the lack of uniformity (Anderson *et al,* 2001).

The CGSB sizing system suggests three body type categories, as shown below (Faust *et al,* 2006):

Junior (odd numbers): 5, 7, 9, 11, 13, 15, 17, 19

Misses (even numbers): 6, 8, 10, 12, 14, 16, 18, 20

Women's sizes (even numbers): 10, 12, 14, 16, 18, 20, 22, 24, 26, 28

or **based on the European system:** 30, 32, 34, 36, 38, 40, 42, 44, 46, 48

2.5.3 Fit problems associated with the different body shape characteristics

Body shape plays a role in interpreting proper fit, as fit is highly dependent on the human proportions. Fit is therefore directly related to the anatomy of the human body and, as pointed out before, most of the fitting problems are created by the bulges of the human body (Yu, 2004a:31-33; Ashdown, 2003). The discussions on the fit problems associated with the different body shapes are summaries based on academic literature on this subject matter by Rasband and Liechty (2006).

2.5.3.1 Fit problems associated with the hourglass body shape

Distinct characteristics of the hourglass body shape which may cause fit problems are: a small/narrow waist, large bust, large hips and large prominent buttocks.

Apparel either fits well at the waist and has a poor fit at the bust and hips, or fits well at the hip and bust area and has a poor fit at the waist. In other words, this figure type needs a smaller size to fit the waistline and a bigger size to fit the hip area. Contrary to the wide hips and large bust, the waist is relatively small, making the figure look out of proportion. The small waist results in excess fabric width around the waistline, causing the garment waist to hang loosely at the waistline or to drop and rest on the larger hip area. However, if the garment has a perfect fit at the waist, then due to the large bust of this shape in proportion to the waist, there will be insufficient fabric width across the bust area, causing tightness resulting in the formation of horizontal wrinkles between the bust tips. A buttoned opening is pulled open between buttons at the bust area and diagonal wrinkles may be formed between the armhole and the bust tip. There will also be inadequate fabric length, width and curved shaping to fit the large prominent buttocks and wide hips comfortably and attractively. As a result the fabric is strained and pulled tight across the buttocks and hips, causing the side seams to bow backward at the low hip level. The strained fabric cups under the buttocks and tight diagonal ripples angled towards the buttocks can be formed. The prominent buttocks and wide hips may pull down the waistline in pants and diagonal wrinkles angled towards the crotch may form (see **Figure 2.10**).

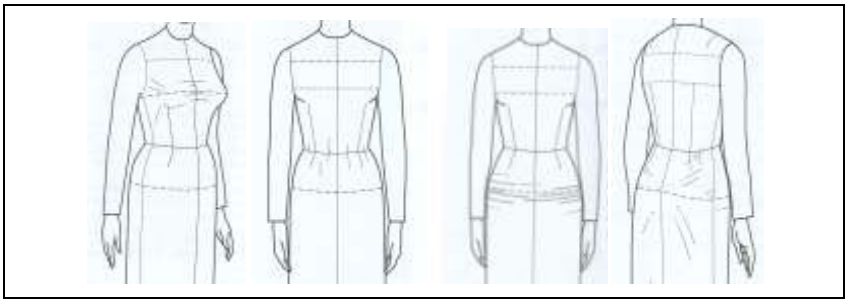


FIGURE 2.10: EXCESS FABRIC WIDTH AROUND THE WAIST (Source: Rasband & Liechty, 2006:194, 210, 288, 314)

2.5.3.2 Fit problems associated with the triangular body shape

The triangular body shape typically has wide/large hips, low hip curve, large thighs, a small bust, narrow shoulders, large prominent buttocks and a flat abdomen.

This means that there is inadequate fabric length, width and curved shaping to fit the large prominent buttocks and wide hips comfortably and attractively. As a result, the fabric is strained and pulled tight across the buttocks causing the side seams to bow backward at the low hip level. The strained fabric cups under the buttocks and tight diagonal ripples angled towards the buttocks may be formed. The prominent buttocks and wide hips may pull down the waistline in pants and diagonal wrinkles angled towards the crotch can form. Due to the low hip curve there is excess fabric width around the upper hip slope, causing slight loose vertical ripples to form in the upper hip area near the side seam.

The large thighs result in insufficient fabric to go around the upper thighs, thus causing tight horizontal ripples or a fold to form around the upper thighs just below the hipline in skirts, while in pants the ripples radiate from the crotch toward the outside thigh and pants creases are pulled outward. There is excess fabric length, width and curved shaping over the abdomen due to the flat abdomen causing the garment shaping to hang loosely in front.
Because of the narrow shoulders and small bust there is excess fabric across the bust and shoulder area, resulting in looseness in those regions. Loose vertical wrinkles or ripples form at the sides of the chest, bust and on the sleeve cap, while the armhole seam falls off the curved end of the shoulder (see **Figure 2.11**).

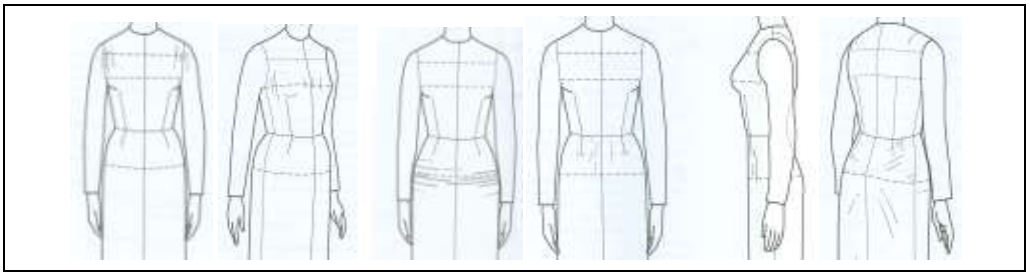


FIGURE 2.11: WRINKLES AROUND THE FULLEST PART OF THE HIPS AND LOOSENESS AROUND THE SHOULDER REGION (Source: Rasband & Liechty, 2006:174, 202, 288, 300, 314)

2.5.3.3 Fit problems associated with the inverted triangular body shape

The inverted triangular body shape has wide shoulders, a large bust, a high hip curve/square, narrow hips, small/flat buttocks and larger upper arms.

The flat buttocks and narrow hips cause excess fabric length, width and curved shaping at the buttock and hip area. As a result the fabric will hang loosely at the back and hips, forming vertical ripples al around the hips and below the back darts and causing the hemline to sag

and pants to hang loosely, lowering the crotch. If ready-to-wear apparel fits at the hips it is usually too small at the waistline.

There is insufficient fabric width across the bust area, shoulder area and upper arms due to the large bust, wide shoulders and larger upper arms. This results in tightness, hence the formation of horizontal wrinkles and ripples between the bust points and across the upper chest, shoulders and upper sleeve. A buttoned opening is pulled open between buttons and diagonal wrinkles may be formed between the armhole and the bust tip. The armhole seam-line is pulled in and short tight wrinkles may radiate from the armhole seam.

Due to the high hip curve there is insufficient fabric to fit comfortably around the upper hip curve, resulting in tightness around this area. In skirts, horizontal wrinkles may ride up seeking a smaller circumference at the waist, while in pants diagonal wrinkles are formed as the fabric is pulled tight between the crotch and upper hip area (see **Figure 2.12**).

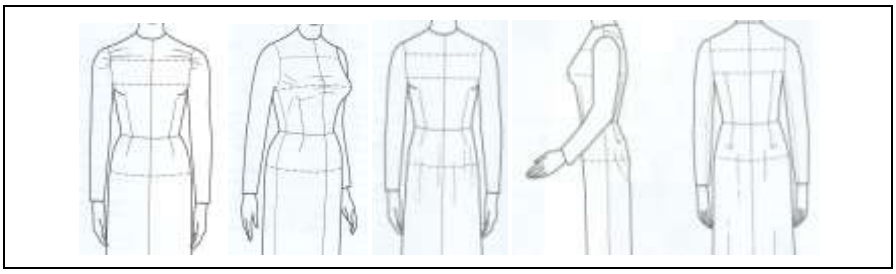


FIGURE 2.12: WRINKLES AT BUST AND SHOULDER REGION AND EXCESS FABRIC AROUND THE HIPS / BUTTOCKS REGION (Source: Rasband & Liechty, 2006:170, 194, 292, 319)

2.5.3.4 Fit problems associated with the rectangular body shape

A distinct characteristic of the rectangular body shape where fit problems may stem from is a wide waistline.

Due to the wide waistline there is insufficient fabric width to fit comfortably around the waist (see **Figure 2.13**). In skirts, a tight horizontal fold forms around the waist as fabric rides up to a smaller circumference, thus shortening the length of the garment. A garment opening is fastened with difficulty as the garment opening edges do not meet. The horizontal fold may be smaller or fail to form in pants as the fabric binds against the crotch.

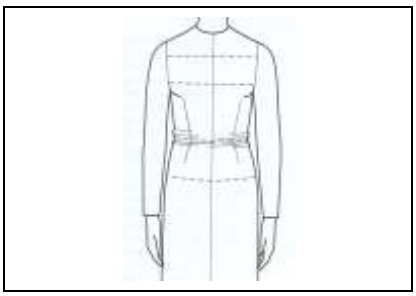


FIGURE 2.13: APPAREL FORMS WRINKLES AT THE WAIST (Source: Rasband & Liechty, 2006:206)

2.5.3.5 Fit problems associated with the diamond body shape

A diamond body shape typically has narrow shoulders, a small bust, a wider/large waist, a high hip curve, narrow hips, flat buttocks and a large prominent abdomen.

Due to the flat buttocks and narrow hips there will be excess fabric length, width and curved shaping at the buttock and hip area. As a result the fabric will hang loosely at the back and hips, forming vertical ripples al around the hips and below the back darts and causing pants to hang loosely, lowering the crotch. Garments that fit at the hips are too small at the waistline.

A one-piece garment is forcefully pulled over the body and the fabric pulls tight across the abdomen and waist. A garment opening is fastened with difficulty; the edges of the opening do not meet as there is insufficient fabric length, width and curved shaping to fit attractively and comfortably over the abdomen and waist. Side seams may bow forward between the waist and upper hip, and a tight horizontal fold may be formed above the abdomen or waist as the fabric rides up, seeking a smaller circumference and thus shortening the length of the garment. The horizontal fold may be smaller or fail to form in pants, as the fabric binds against the crotch. Tight diagonal ripples angled towards the stomach curve and vertical wrinkles often form between the crotch and abdomen as the fabric is pulled uncomfortably tight.

Due to the narrow shoulders and small bust there is excess fabric across the bust and shoulder area, resulting in looseness in those regions. Loose vertical wrinkles or ripples form at the sides of the chest, bust and on the sleeve cap, while the armhole seam falls off the curved end of the shoulder. There is insufficient fabric to fit comfortably around the upper hip curve due to the high hip curve, resulting in tightness around this area. In skirts, horizontal

wrinkles may ride up seeking a smaller circumference at the waist, while in pants diagonal wrinkles are formed as the fabric is pulled tight between the crotch and upper hip.
Though this is not a common figure type it is notable that it has various fit problems due to its conformation (see **Figure 2.14**).

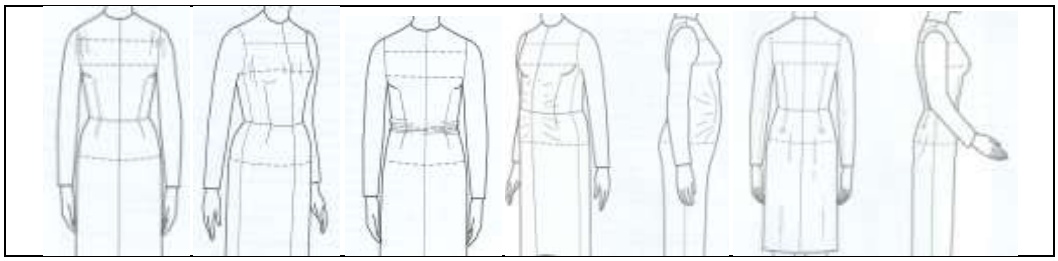


FIGURE 2.14: WRINKLES AND STRAIN FOLDS RADIATING FROM THE LARGE PROMINENT STOMACH AND APPAREL SHAPING HANGS LOOSELY AT THE BACK, BUST AND SHOULDER REGION (Source: Rasband & Liechty, 2006:174, 202, 206, 304, 319)

2.5.3.6 Fit problems associated with the round body shape

A round body shape typically has full-rounded body areas all over. The upper back and upper arms are larger and rounded. The bust, midriff, waist, abdomen, buttocks, hips and upper legs are also larger and rounded.

There is inadequate fabric length, width and curved shaping to fit the large prominent buttocks and wide hips comfortably and attractively. As a result the fabric is strained and pulled tight across the buttocks, causing the side seams to bow backward at the low hip level. The strained fabric cups under the buttocks and tight diagonal ripples angled towards the buttocks may be formed. The prominent buttocks and wide hips may pull down the waistline in pants and diagonal wrinkles angled towards the crotch may form.

The edges of a garment opening do not meet, hence the garment opening is fastened with difficulty as there is insufficient fabric length, width and curved shaping to fit attractively and comfortably over the abdomen and waist. A one-piece garment is forcefully pulled over the body and the fabric pulls tight across the abdomen and waist. Side seams may bow forward between the waist and upper hip and a tight horizontal fold may be formed above the abdomen or waist as the fabric rides up, seeking a smaller circumference and thus shortening the length of the garment. The horizontal fold may be smaller or fail to form in pants as the fabric binds against the crotch. Tight diagonal ripples angled towards the

stomach curve and vertical wrinkles often form between the crotch and abdomen as the fabric is pulled uncomfortably tight.

Because of the large bust and midriff area of this shape there is insufficient fabric width across the bust area, leading to tightness and resulting in the formation of horizontal wrinkles between the bust tips. A buttoned opening is pulled open between buttons at the bust and midriff area and diagonal wrinkles may be formed between the armhole and the bust tip. There is also insufficient fabric width across the upper arms and upper back areas due to the size and roundness of these areas. This results in tightness and the formation of horizontal wrinkles and ripples across the upper back and upper sleeve. The armhole seam-line is pulled in at the back and short tight wrinkles may radiate from the armhole seam.

The leg bones are larger and carry more weight than average and the weight is distributed on the upper leg. Consequently, there is insufficient fabric width to fit comfortably around the upper leg, thus tight horizontal ripples or wrinkles may be formed around the upper leg which may bind the fabric and cause it to ride up (see **Figure 2.15**).

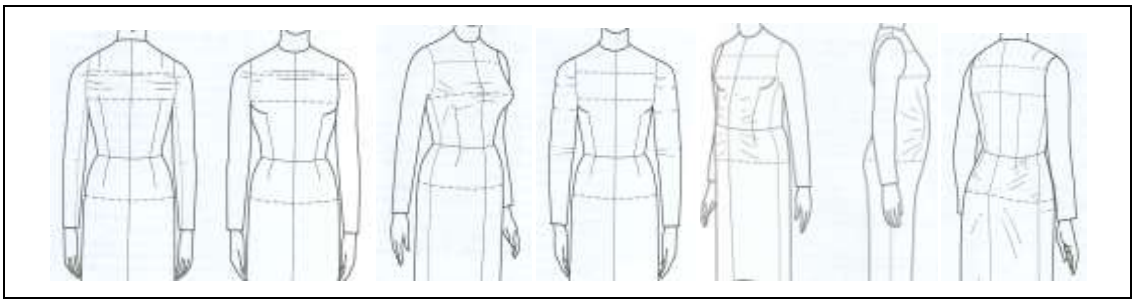


FIGURE 2.15: WRINKLES AT WAIST/MIDFIFF, ACROSS CHEST AND UPPER BACK REGION, AND STRAIN LINES/RIPPLES RADIATING FROM BUTTOCKS, BUST AND UPPER ARMS (Source: Rasband & Liechty, 2006:186, 194, 228, 304, 314)

In summary, the round- and diamond-shaped women generally experience more fit problems as a consequence of their body shape, while the rectangular body shape is prone to minimal fit problems. With adequate weight loss to an acceptable weight range for height, however, the round figure type would look more like one of the other figure types discussed above.

2.5.4 Posture and proportion variations and associated fit problems

In addition to the fit implications associated with the different body shapes discussed above, fit problems are further caused by the postural alignment of the body, pelvic tilt, back type,

body proportions in terms of height, abdomen, buttock and thigh relationship, and the bust and back relationship. These postural and proportion variations are not typical of any specific body shape but can occur in any of the body shapes (Tate & Edwards, 1991; Armstrong, 1995; Rasband & Liechty, 2006).

2.5.4.1 Postural alignment variations

Posture refers to the position in which the body is held upright against gravity while standing, sitting or lying down. Good posture involves training the body to stand, walk, sit and lie in positions where the least strain is placed on supporting muscles and ligaments during movement or weight-bearing activities. Good posture keeps bones and joints in the correct alignment so that muscles are used properly and prevents the spine from becoming fixed in abnormal positions, thus improves the fit of apparel (Rasband, 1994:13; Rasband & Liechty, 2006:29). Under normal circumstances the spine has three normal curves, i.e. cervical, thoracic and lumbar curves (**Figure 2.16**).

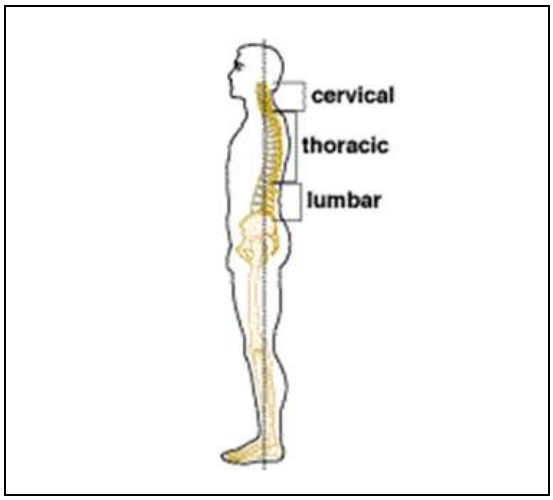


FIGURE 2.16: THE THREE NORMAL SPINAL CURVES

Posture or figure stance and back types have a direct effect on the hang and balance of garments on the body, hence ultimately has influence on the fit and comfort of apparel. The hemline for example may fall downward when the posture has a forward stance or ride upward in an upright stance (Armstrong, 1995).

2.5.4.1.1 Perfect posture

In perfect posture, the earlobe is in alignment with the plumb line, while the wrist bone is slightly forward of the line and the back ideally curves slightly outward. The perfect posture

does not pose any fit problems as all the body areas are well aligned and symmetrical (**Figure 2.17**).

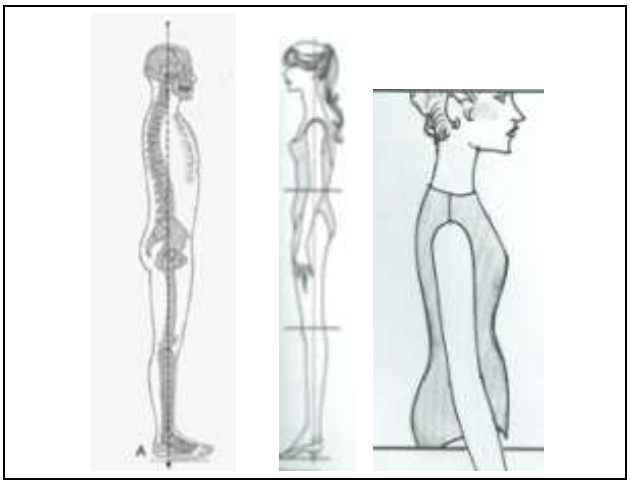


FIGURE 2.17: PERFECT POSTURE (Source: Armstrong, 1995:36, 39)

2.5.4.1.2 Forward posture and associated fit problems

The earlobe and the wrist bone are both forward of the plumb line. The buttocks protrude less than average or ideal, thus this figure stance often occurs in combination with flat buttocks. The top of the pelvis tilts backwards, causing the waist to appear to indent more than average. The hemline may fall downward at the back and round out or rise in front due to the fact that the top of the pelvis tilts backwards, causing the waist to appear to indent more than average; fabric also sags under the buttocks and there is too much fabric shaping and length across the buttocks. Skirt side seams slant forward and pants side seams bow, while droopy, diagonal wrinkles form across the back crease lines (**Figure 2.18**).

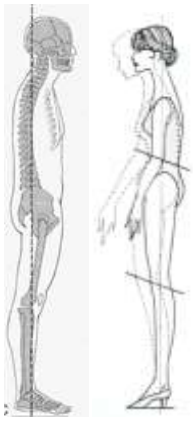
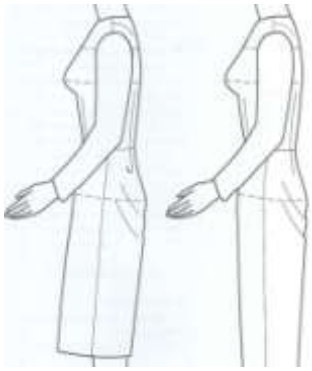
Forward posture	Fit problems associated with the forward posture
	

FIGURE 2.18: FORWARD POSTURE AND ASSOCIATED FIT PROBLEMS (Source: Armstrong, 1995:39; Rasband & Liechty, 2006:332)

2.5.4.1.3 Upright posture and associated fit problems

The earlobe is at or behind the plumb line, while the elbow and the wrist bone are slightly forward or slightly back of the line. The top of the pelvis tilts forward, thus lifting the buttocks up and outward. The buttocks protrude more than average and the groin area indents more than average. The distance between the waist and the buttocks is decreased, while the distance between the buttocks and the crotch at body centre increases.

The hemline may be pulled up in the back, resulting in the hemline poking out at the centre back due to the forward pelvis tilt which lifts the buttocks up and outward. Due to the decreased distance between the buttocks and the waist, there is too much fabric length between the buttocks and the waist, causing a horizontal fold to form just below the waist that tapers to nothing at the side seam.

In pants, fabric binds against the crotch and is pulled tight under the buttocks because the distance between the buttocks and the crotch at body centre is increased. The waistband is pulled down at the back and wrinkles that angle toward the inside seam may be formed (**Figure 2.19**).

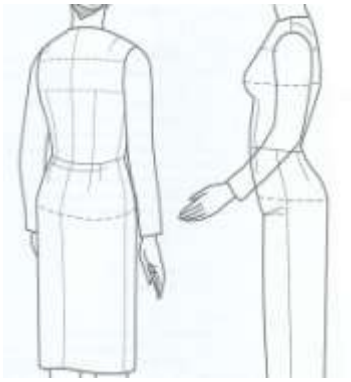
Upright posture	Fit problems associated with the upright posture
	

FIGURE 2.19: UPRIGHT POSTURE AND ASSOCIATED FIT PROBLEMS (Source: Armstrong, 1995:39; Rasband & Liechty, 2006:336)

2.5.4.1.4 Scoliosis sideways and associated fit problems

Scoliosis sideways refers to the curvature of thoracic spine or backbone that is oriented sideways. The pelvis tilts upwards on one side and tilts downwards or is normal on the other side. One shoulder may appear elevated or normal, while the other one is sloped in comparison. Due to the decreased distance between the armhole and hip-level at the side seam on one side, there is too much fabric length causing horizontal folds to form at the

affected side seam that tapers to nothing toward the opposite side seam. This will lead to an imperfectly balanced garment as the hem will be pulled up and the shoulder seam will slope more than the ideal level on one side (**Figure 2.20**).

Scoliosis sideways	Fit problems associated with the Scoliosis sideways posture
	

FIGURE 2.20: HORIZONTAL FOLDS AT THE AFFECTED SIDE SEAM AND LOOSE DIAGONAL WRINKLES BETWEEN THE NECK AND UNDERARM (Source: Armstrong, 1995:13; Rasband & Liechty, 2006:126)

2.5.4.2 Back types

2.5.4.2.1 Flat back and associated fit problems

The flat back has a straight back with no curve to a very slight curve. The distance between the neck and mid-back is decreased. This type of back often occurs in combination with square shoulders or a prominent bust.

There is excess fabric length and curved shaping which sags, causing horizontal ripples in the upper back due to the decreased distance between the neck and mid-back. The waistline may sag as the distance between the nape and back waist is decreased (**Figure 2.21**).

Flat back	Fit problems associated with a flat back
	

FIGURE 2.21: EXCESS FABRIC LENGTH AND CURVED SHAPING IN UPPER BACK REGION (Source: Armstrong, 1995:36; Rasband & Liechty 2006:158)

2.5.4.2.2 Round back and associated fit problems

The round back, also known as Kyphosis lordosis, is characterised by the backward curvature of the thoracic spine, thus has a dominant outwardly curved back. The entire upper back curves outwards more than average, hence the distance between the nape and the mid-back is increased. This back variation may occur in combination with a forward shoulder, dowager curve or shallow chest.

Due to the increased distance between the nape and mid-back there is not enough fabric length in the upper back area. Apparel is therefore pulled tight in the upper back area, causing the waistline to be pulled at the centre back and diagonal strain wrinkles to form between the neck and armhole (**Figure 2.22**).

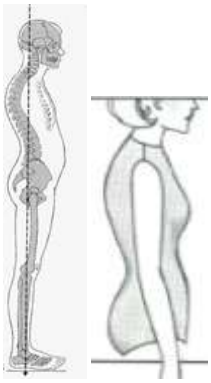
Round back	Fit problems associated with a round back
	

FIGURE 2.22: DIAGONAL WRINKLES FORM BETWEEN THE NECK AND ARMHOLE (Source: Armstrong, 1995:36; Rasband & Liechty, 2006:154)

2.5.4.2.3 Dowager's hump/curve and associated fit problems

The dowager's hump or curve has a rounded, protruding hump or curve. The upper back curves outward more than average at the neck base. The length and width increase at the centre back base of the neck. This back variation may occur in combination with a forward neck and head, rounded upper back and shallow chest.

There is not enough fabric length to fit the upper centre back, causing the back waistline to be pulled up and tight. A circular wrinkle may form around the neckline at the front due to the strain from the pulled up neckline that locates at a higher smaller neck circumference.
A fold or horizontal ripple may form at the back armhole due to the curvature at the centre back and may pull tight across the upper back (**Figure 2.23**).

Dowager's hump/curve	Fit problems associated with a Dowager's hump/curve
	

FIGURE 2.23: CIRCULAR WRINKLE AROUND NECKLINE AT THE FRONT (Source: Armstrong, 1995:36; Rasband & Liechty, 2006:150)

2.5.4.3 Body proportions

The relationship of body segments to one another and to the whole body is referred to as body proportion and is also used to describe the shape of the body (Riegelman, 2003). The body can therefore be divided into proportional areas which vary from one individual to the next. The proportional areas can be in terms of length, width or size, usually identified by break points at joints, i.e. where the body silhouette changes in direction and creates an angle. Examples of body proportional areas include bust to waist, neck to shoulder, bust to hip or waist to hip. These body parts can be compared to one another and their relationship established (Rasband & Lietchy, 2006). The ideal figure body shape is said to be proportional. Ideal body proportions are however dependent on culture and fashion trends.

Very few people conform to the ideal body type, yet ready-made apparel is based on the ideal figure. This has led to many problems with fit issues and is sometimes compensated for by dressing to draw attention away from areas that are not proportional. Variations in body

proportions can be determined through anthropometry. Variations could be in the nature of shorter than average legs, asymmetrical body parts, high or low hip level, or narrow or wide shoulders (Rasband & Liechty, 2006:22-23; LaBat & DeLong, 1990). Where one curves and how much one curves depends on bone size and structure, proportional areas, weight, muscle tone, pattern of weight distribution and posture.

Bone size and bone structure, for example, determine the original structure of the curves; weight determines how much these contours fill out (Li, Ulrich & Connell, 2003; Simmons, 2002; McRoberts, 2005). The fine distinction among female body shapes needs to be understood in a way that will reflect all the experiences of fashion stakeholders to enhance pattern development which will better fit today's ethnically and physically diverse female population. There are a number of influential factors that influence the development of a human body; these include lifestyle, food habits, genetic and environmental factors. These factors conform the bodies of a population to different body strata. There is a significant variance in body proportions of different ethnic groups (Tamburrino, 1992b).

2.5.4.3.1 Height proportions and associated fit problems

Height is a critical body dimension in the identification of body shapes and body proportions as it is said to affect these. Individuals may have the same height but appear shorter or taller in comparison due to different body height proportions, e.g. long legs and a short torso or short legs and a long torso (**Figure 2.24**).

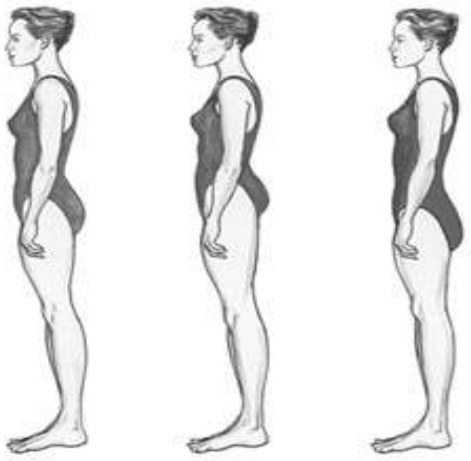
Normal height proportions	Height proportions variations		
			
	A	B	C

FIGURE 2.24: NORMAL HEIGHT PROPORTIONS AND VERTICAL BODY SHAPE/HEIGHT PROPORTIONS VARIATIONS (Source: Riegelman, 2003:18; Liddelow, 2007)

The proportions of the human figure are equivalent to eight heads, of which each proportion is measured in relation to the length of the head. The hip height is said to halve the total height, i.e. 4 heads/8 heads (½) and the waist height is 5 heads/8 heads (⅝) (Riegelman, 2003:18). Short summaries of the different vertical body shapes/height proportions are discussed below.

Balanced/ideal height proportion

The balanced height proportion gives an impression of perfect proportions, hence it is said to be ideal. The upper body length is relatively the same as the lower body length. The bust-line is midway between the shoulders and the waistline, the waistline is midway between the bust-line and the hipline, and the hipline halves the total height (**Figure 2.24: A**).

Long legs & short torso/high waist

This height variation gives an illusion of tallness, i.e. one may look taller, yet in reality, one may be short to average in height. It is more appreciated than a long-waist figure in the fashion industry, hence the fashion figure has elongated legs with a proportion of three heads from the knees compared to the two heads for a normal height proportion. The bust-line, waistline and the hipline are above the bust-line, waistline and hipline levels of the ideal height proportions (**Figure 2.24: B**).

Short legs & long torso/low waist

This height variation gives an impression of shortness due to the short legs, compared to the upper body, while in actual fact the height may be average or tall. The buttocks and thighs appear to be low and heavy due to the long torso. The bust-line, waistline and the hipline are below the bust-line, waistline and hipline levels of the ideal height proportions. Pants are often too long and require some alterations to fit the short legs (**Figure 2.24: C**).

2.5.4.3.2 Abdomen, buttocks and thigh relationship

2.5.4.3.2.1 I-shape and associated fit problems

The I-shape has flat buttocks and a flat abdomen. Due to the flat abdomen and the flat buttocks there is too much fabric length, width and curved shaping over the abdomen and buttocks, causing the garment to hang loosely at the front and back. Vertical ripples may form below the darts and the hemline may sag at the centre front and back. In pants the crotch seam may drop slightly and at the back pants legs, diagonal ripples can form as the fabric droops due to the looseness. These fit problems are worsened by the looseness both at the front and back (**Figure 2.25**).

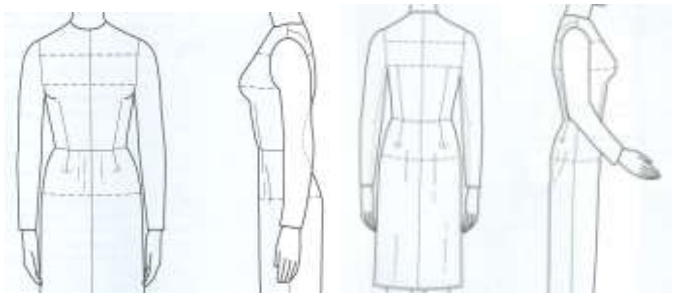
I-shape	Fit problems associated with the I-shape
	

FIGURE 2.25: EXCESS FABRIC WIDTH, LENGTH AND CURVED SHAPING AT THE STOMACH AND BUTTOCK REGION (Source: Armstrong, 1995:40; Rasband & Liechty, 2006:300, 319)

2.5.4.3.3.2 R-shape and associated fit problems

The R-shape has flat and low buttocks, large abdomen and well-rounded thighs. Due to the flat low buttocks there is too much fabric length, width and curved shaping over the buttocks, causing the garment to hang loosely at the back and a tapered horizontal tuck forms below the buttocks, and the waistline and hip fitting line are pulled down at the centre back. Vertical ripples may form below the back darts and the hemline may sag at the centre back. In pants the crotch seam may drop slightly and at the back pants legs, diagonal ripples can form as the fabric droops due to the looseness.

The large abdomen causes strain over the abdomen as there is insufficient fabric length, width and curved shaping to fit attractively. Tight diagonal ripples may form, angled toward the stomach curve. In close-fitting skirt styles, the fabric may cup under the abdomen and the hemline may be pulled up in front. The fit problems due to the large abdomen may however be softened by the looseness at the back due to the flat low buttocks. Strain lines may also be evident around the thighs (**Figure 2.26**).

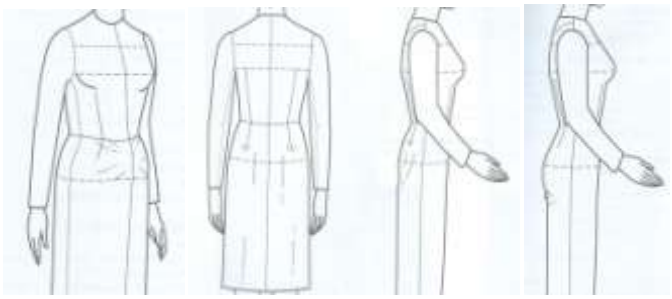
R-shape	Fit problems associated with the R-shape
	

FIGURE 2.26: TIGHT DIAGONAL RIPPLES ANGLED TOWARD STOMACH CURVE AND EXCESS FABRIC AROUND BUTTOCK AREA (Source: Armstrong, 1995:40; Rasband & Liechty, 2006:296, 319, 328)

2.5.4.3.2.3 S-shape and associated fit problems

The S-shape has large buttocks, a flat abdomen and large thighs. Due to the large buttocks and large thighs there will be fit problems associated with them in the form of inadequate fabric length, width and curved shaping to fit the buttocks comfortably and attractively. The fabric around the buttocks is strained and pulled tight across, while also cupping under the buttocks. Side seams bow backward at the low hip level, while tight diagonal ripples may form, angled toward the buttock curve or toward the crotch in pants. The pants waistband may be pulled down at the back, while a skirt hemline can be pulled up in the back, causing the hemline to poke out at the centre. Due to the large thighs, fabric is inadequate and tightened across the upper thighs and cups under the buttocks. In pants a horizontal fold may form at the crotch level, above the thighs, or horizontal ripples may radiate from the crotch toward the outside thigh and pants creases are pulled outward at the upper hip, while the side seams may be pulled forward at the upper front thigh level. In skirts, tight horizontal ripples or a fold may form around the upper thighs, just below the hipline (**Figure 2.27**).

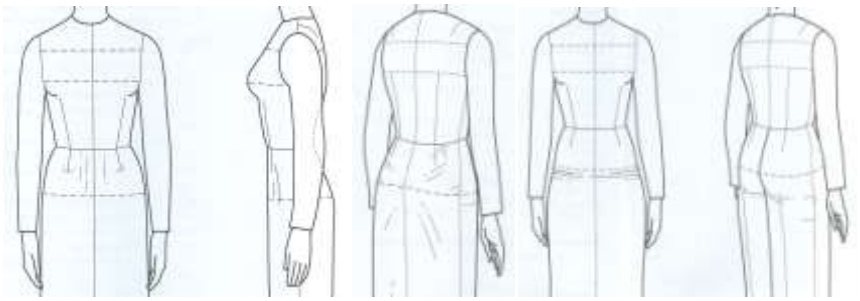
S-shape	Fit problems associated with the S-shape
	

FIGURE 2.27: WRINKLES AROUND FULLEST REGION OF BUTTOCKS AND THIGHS AND EXCESS FABRIC AROUND STOMACH AREA (Source: Armstrong, 1995:40; Rasband & Liechty, 2006:300, 314, 340)

2.5.4.3.2.4 Oval O-shape and associated fit problems

The oval O-shape has a high protruding abdomen and low protruding buttocks. The high protruding abdomen results in inadequate fabric length and width and curved shaping to fit comfortably and attractively over the abdomen. If the garment has an opening, the edges of the opening do not meet easily. If the garment is fastened or pulled over forcefully, the fabric is pulled tight across the abdomen and the hem rises and forms a bow at the centre front, side seams bow forward from above the waist to the hem and at the centre front, and a horizontal fold forms above the abdomen as the fabric rides up to a wider width.

Due to the low protruding buttocks the fit of pants is affected as the centre back pants seam is pulled into the crotch, causing discomfort to the wearer. A tapered horizontal tuck forms below the buttocks and the waistline and hip fitting line are pulled down at the centre back (**Figure 2.28**).

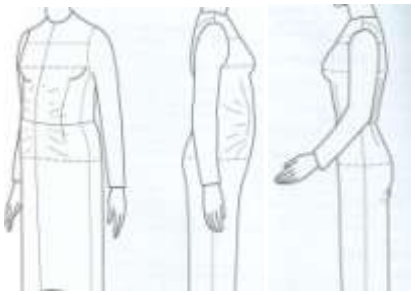
Oval O-shape	Fit problems associated with the Oval O-shape
	

FIGURE 2.28: WRINKLES AROUND WAIST/MIDRIFF REGION AND HORIZONTAL TUCK BELOW BUTTOCKS (Source: Armstrong, 1995:40; Rasband & Liechty, 2006:304, 328)

2.5.4.3.2.5 O-shape and associated fit problems

The O-shape has the abdomen and buttock protrusion at the same level. Due to the buttock protrusion which is at the same level as the abdomen protrusion, there is inadequate fabric length, width and curved shaping to fit the buttocks and abdomen comfortably and attractively. The fabric around the buttocks and abdomen is strained and pulled tight across, while also cupping under the abdomen or buttocks or both. Side seams bow backward at the low hip level, while tight diagonal ripples may form, angled toward the buttock and abdominal curve or toward the crotch in pants. The pants waistband may be pulled down at the back, while a skirt hemline can be pulled up in the back, causing the hemline to poke out at the centre (**Figure 2.29**).

O-shape	Fit problems associated with the O-shape
	

FIGURE 2.29: TIGHT DIAGONAL RIPPLES ANGLED TOWARD STOMACH AND BUTTOCK CURVE (Source: Armstrong, 1995:40; Rasband & Liechty, 2006:296, 314)

2.5.4.3.3 Bust and back relationship variations

2.5.4.3.3.1 Ideal back and bust relationship

The back and bust relationship is said to be ideal when there is a slightly more view of the bust than the back (B-cup). There are no fit problems associated with this bust and back relationship as it is considered to be ideal (**Figure 2.30**).

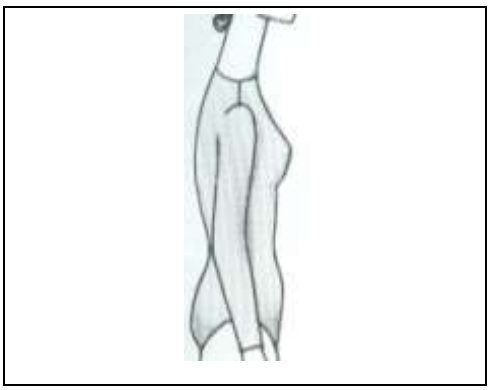


FIGURE 2.30: IDEAL BUST AND BACK RELATIONSHIP (Source: Armstrong, 1995:36)

2.5.4.3.3.2 Large bust, small back (C-, D-, or DD-cup) and associated fit problems

The bust or breasts are larger than average, i.e. based on the assumption that an average cup is a B and is prominent compared to the small back. The breasts typically have a pointed shape and are usually a C-cup or larger. The back on the other hand is smaller and narrower than average, and can sometimes occur in combination with an erect back, making the bust look even more prominent.

There is insufficient fabric width and length, hence tightness as the fabric is strained across the bust area due to the large bust. The waistline and hemline are slightly raised from their position and the bodice side seams bow forward. Ripples and wrinkles radiate from the bust tip to the armhole and waist. Due to the small back, there is too much fabric width across the upper back, making the garment loose in that region. Consequently, loose vertical ripples form at the sides of the upper back near the armhole seam (**Figure 2.31**).

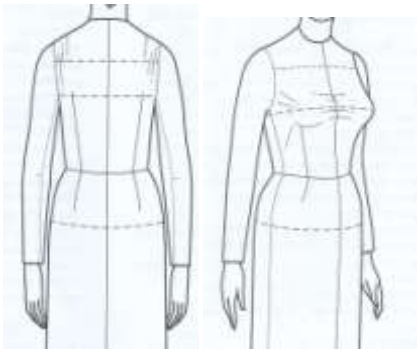
Large bust, small back (C-, D-, or DD cup)	Fit problems associated with the Large bust, small back (C-, D-, or DD-cup)
	

FIGURE 2.31: EXCESS FABRIC WIDTH ACROSS UPPER BACK AND HORIZONTAL AND DIAGONAL WRINKLES AROUND BUST REGION (Source: Armstrong, 1995:36; Rasband & Liechty, 2006:190, 194)

2.5.4.3.3.3 Small bust, large back (A-cup) and associated fit problems

The back is wider than average and the increased back width can affect the upper back and extend lower to the midriff area; this often occurs in combination with broad shoulders. The bust or breasts are smaller than average, based on the assumption that average is a B-cup and the width across the bust area is reduced.

Due to the small bust, there is excess fabric width, hence looseness across the bust area and vertical wrinkles or ripples may form across or at the sides of the bust. The length over the bust may be affected due to the looseness that may cause slight sagging, forming a loose horizontal fold underneath the bust. The sagging may also affect the waistline and hemline orientation. The large back, on the other hand, results in insufficient fabric width across the back, thus the garment is pulled tight forming tight horizontal wrinkles, and the sleeve seams may be pulled inward toward the back (**Figure 2.32**).

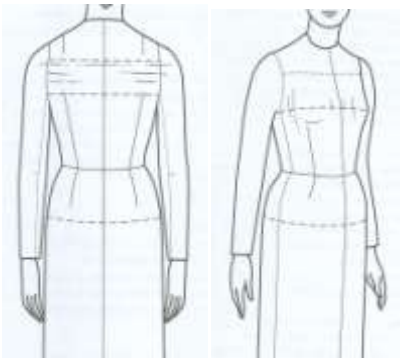
Small bust, large back (A-cup)	Fit problems associated with the small bust, large back (A-cup)
	

FIGURE 2.32: TIGHT WRINKLES ACROSS UPPER BACK AND EXCESS FABRIC AROUND BUST (Source: Armstrong, 1995:36; Rasband & Liechty, 2006:186, 202)

2.5.4.3.3.4 Hollow chest and associated fit problems

The chest is flatter than average, forming a concave above bust and no chest curve below the neck, thus the distance across and over the upper chest is reduced. This variation often occurs in combination with a rounded upper back and forward shoulders.

Due to the hollow chest the distance over and across the upper chest is reduced, thus there is excess fabric length and width over the upper chest. Consequently, the garment hangs and sags in the upper chest area above the bust, forming loose horizontal folds or ripples (**Figure 2.33**).

Hollow chest	Fit problems associated with the hollow chest
	

FIGURE 2.33: EXCESS FABRIC LENGTH & WIDTH ACROSS UPPER CHEST (Source: Armstrong, 1995:36; Rasband & Liechty, 2006:166)

2.5.4.3.3.5 Pigeon breast and associated fit problems

There is a protruding bone above the bust, i.e. the sternum protrudes more than average and the chest rounds out just below the neck, thus the distance over and across the upper chest is increased. Due to the protruding bone there is insufficient fabric, thus tightness across the upper chest. This may cause the formation of diagonal wrinkles between the neckline and armhole (**Figure 2.34**).

Pigeon breast	Fit problems associated with the pigeon breast
	

FIGURE 2.34: DIAGONAL WRINKLES BETWEEN THE NECKLINE AND ARMHOLE (Source: Armstrong, 1995:36; Rasband & Liechty, 2006:162)

2.5.4.3.4 Shoulder and hip relationship

The shoulder hip relationship is critical in shape analysis as it is used when identifying the different body shapes, e.g. the hourglass shape is said to be aligned at the hips and shoulders and the triangular body shape is said to be wider at the hips in comparison to the narrow shoulders.

2.5.4.3.4.1 Ideal

The shoulders and hips are aligned and the difference between the waist and hip is between 25 cm and 28 cm. It is used to identify the ideal body shape.

2.5.4.3.4.2 Hourglass

The shoulders and hips are aligned and the difference between the waist and hip is 33 cm or more. It is used to identify the hourglass body shape.

2.5.4.3.4.3 Straight line

The shoulders and hips are aligned and the difference between the waist and hip is 20 cm or less. It is used to identify the rectangular body shape.

2.5.4.3.4.4 Wide shoulders, small hips

The shoulders are wider than the hip width. It is used to identify the inverted triangular body shape.

2.5.4.3.4.5 Narrow shoulders, large hips

The hip width is wider than that of the shoulders. It is used to identify the triangular body shape.

There are congruencies that are noted in the shoulder and hip relationships and the distinct characteristics of the body shape variations. In other words, the relationship between the shoulders and the hips give the body its characteristic shape.

2.5.5 Apparel styles and designs suitable for different figure/body shapes

For a figure type to look its best, understanding what clothing works best for the different body types is important. Choosing apparel that is right for a particular shape will give it the most flattering look. The ideal body shape is said to be aligned at the lower and upper body parts, it has a defined waist which is considered feminine and slim-looking, and there is no single part that is out of proportion in the silhouette that dominates the shape; however not all women have the ideal shape. The eye is attracted to symmetry, i.e. it is visually pleasing to the eye, therefore the main aim when dressing is to create balance on the body shape and proportions by accentuating the good features and drawing attention away from the problem areas, thus giving an illusion of a proportional ideal body shape. The delineation on the suitable styles and designs for the different body shapes below is based on the experiences, observations and academic literature of the following sources: Rasband (1994); Rasband (1996), Rasband & Liechty, (2006); www.thechicfashionista.com; www.style-makeover-hq.com.

2.5.5.1 Apparel styles and designs suitable for the hourglass body shape

As mentioned many times, the hourglass body shape is considered the most ideal body shape as it is said to be proportionally balanced, the shoulder/bust is said to be aligned to the hip and it has a defined waistline. Gained weight is usually distributed evenly throughout the proportional curves.

Ready-to-wear apparel is manufactured based on this silhouette. Though this shape is much easier to dress because it is proportionally balanced, one should aim to emphasise the good features of the shape instead of hiding them with the apparel items when dressing the

hourglass shape. This can be achieved by avoiding stiff boxlike apparel, but concentrating on clothes and accessories that accentuate the proportional areas by using the waist as a focal point.

The waist is an ideal focal point for this figure type, thus anything that wraps closely around the smallest part of the waist draws attention to it and brings out the perfect proportions. Voluminous skirts (including the bottom of dresses) such as a full circle or tulip skirt, are ideal as they make accentuate the small waist. A-line and pencil skirts also look flattering on this figure.

Soft fabrics such as knits and liquid silk blends, as well as fabrics with a bit of stretch are ideal, as they accentuate and complement the curves as they drape over the figure. Attention should be given to the hip and bust areas to ensure that they are not over-accentuated, as they may make the small waist appear even smaller. To downplay these parts, clothes with vertical details such as pleats, vertical prints, or buttons placed downwards should be used. Straight and boot-cut pants and jeans that fit the hips snugly, heels to elongate the legs, low necklines to slim down the torso, tops that extend just below the hipbone or past the thighs are ideal. To avoid adding width to the legs and hips, leggings can be worn with long-length tops.

2.5.5.2 Apparel styles and designs suitable for the triangular body shape

A triangular body shape is typically heavier below the waist, specifically at the hips and thighs, and narrow above the waist, i.e. at the bust and shoulders, with a small to medium bust. If an outfit fits perfectly from the waist down, it often needs a lot of alterations above. The main aim is to accentuate the positive features of this shape, i.e. a shapely waist, delicate upper body and attractive shoulders and arms, and to create width in the upper body to balance the full lower half. Horizontal necklines, smooth, matt fabrics below the waistline, darker colours in skirts and pants, straight or slightly-tapered trousers and skirts, high-positioned accessories and medium to high heels are a few ways in which this can be achieved.

For the **bottoms** it is essential to avoid anything too tight as it draws attention to the wide hips. A-line skirts that are knee length are ideal because they draw attention away from problem areas, while miniskirts are generally not ideal because they accentuate heavy thighs. Pants waistlines should fall somewhere below the natural waistline for a better fit. A straight or slightly boot-cut leg is the most flattering. Big cargo pockets, ruching or excessive zippers, patterned or light-coloured pants around the hip area are not ideal, as they capture

the eye and draw attention to the wide hip area. Lightweight, loose-fitting shorts, preferably with slimming side stripes, give an illusion of sleekness.

For **tops,** bottom-heavy shaped women should avoid too-baggy or too-tight tops, as the looser tops make the figure look large all over and the tight tops make the figure look out of proportion to the hips. Fitted but not skin-tight T-shirts, e.g. with some stretch and button-front tops, are suitable to accentuate the upper body. V-necks, turtlenecks and open collars all call attention to the face, which is desirable. The length of jackets and blazers should not be up to the widest point of the hips but can for instance go up to right below the waist to mid-thigh, depending on height, to avoid exaggerating the hips.

Dresses that nip in at the waist and slightly flare out over hips and thighs are suitable, as they accentuate the shapely waistline while de-emphasising the wide hips and bulky thighs, e.g. a full-skirted ball-gown because it hides heavy hips and thighs. Sleeveless and strapless dresses are ideal to accentuate the attractive shoulders and arms. An empire, or raised-waist dress brings the eye up away from hip and thigh problem areas, though sometimes this can be mistaken for a maternity look with fuller figures.

2.5.5.3 Apparel styles and designs suitable for the inverted triangular body shape

The inverted triangular body shape, which is also referred to as an apple shape body type, is typically softer around the waist and has heavier breasts, with narrower hips and slimmer long legs. The main aim when dressing this figure type is to balance the full upper body by increasing the visual width below the waist. This figure can be emphasised by accentuating the legs and cleavage. An attractive silhouette can be achieved by creating balance between the larger bust and shoulders, and thinner legs. Tops that are too tight should be avoided as they draw attention to the large breasts and accentuate top-heaviness, and baggy tops with full or puffy sleeves also make the bust area look even heavier. Fabrics that slim the body such as knits and soft woven fabrics with a degree of stretch give the top part of this body shape a better fit.

For bottoms, A-line skirts or skirts with patterns or bold textures will draw attention away from the bust area to the small hip area, while dresses in solid colours balance the bust and hip areas. Short skirts paired with slimming tunic tops are ideal as the short skirt shows the legs while moving attention away from the narrow hips, and the slimming tunic top de-emphasises the large bust by giving it a slim look. Horizontal stripes below the waist and fuller-leg trousers take the eye across the hip area, creating an illusion of width at the hip area, thus balancing the bust and hip areas. Single-breasted jackets and garments that are smooth and

soft in texture are suitable to avoid adding width and bulk to the already wide bust. Vertical lines in garments should be worn above the waist or throughout the entire garment to help carry the eye up and down, narrowing the bust to balance it with the hip area. Narrow collars and lapels, short loose sleeves hemmed just above or below the fullest part of the bust are ideal.

Scooped neck, V-neck tops, boat-neck, turtle and mock necks and shirt collars are flattering necklines for this figure type and can be worn with boot-cut or slightly flared mid-rise jeans or wide-legged trousers. The necklines draw attention away from the large bust and shoulders to the neckline and give it an elongated neck look, while the slightly flared jeans add an illusion of bulk at the hipline to balance the body. Flat front, never pleated pants that have a lower rise than the natural waist are suitable, to avoid adding bulk. Front pockets on jeans help disguise a big abdomen, while back pockets help define a flatter rear common to top-heavy women. Anything that is too tight should be avoided, e.g. pencil skirts or skin-tight jeans, because it only accentuates top-heaviness.

Dark and solid colours for tops are suitable for the inverted triangular shape because they create a more balanced appearance when compared with slim legs. A monochrome outfit can help create a longer, leaner look. Paired with accessories at the neckline, like a bold scarf or chunky necklace, could add visual interest and create a balanced look. Light layers, like camisoles paired under structured jackets, are also good clothing choices for this shape to avoid adding bulk. Avoid thick, chunky fabrics, and choose tops that go slightly longer than the mid-section.

2.5.5.4 Apparel styles and designs suitable for the rectangular body shape

This figure shape is balanced at the hip and shoulder/bust areas, has little or no waistline definition and often comes in combination with long legs. Weight gain is distributed evenly throughout the body frame. The main aim is to visually make the torso look slimmer and lengthened, create a strong shoulder line and the illusion of a waistline without widening the already wide waistline. Rectangular body shaped women can add dimensions to the body frame by using clothes, textures and details to give an illusion of breaking up the silhouette to create curves from the waist up and from the waist down. Various cuts and shapes, e.g. wide-leg jeans, tulip skirt, kimono top, and various prints, textures and details, e.g. ruffles, prints, tiers, studs, frills, bows, rosettes and beads. Layering fitted garments and the use of bright tones also absorb the eye.

A thick and undefined waist will make the figure look shorter and heavier, thus definition can be given to the waist by using a push-up bra, which will lift up the chest and make the bust area noticeably defined, showing the waistline. Attention should be given to the waist to make it appear trim and defined, for instance by wearing tops with details from the chest and up together with a bottom with shape, e.g. boot-cut jeans or an A-line skirt, and wearing a belt around the waist in dresses and tops for adding shape to the straight frame. Simple belts in dark in colours are suitable because detailed and brightly coloured belts placed on the waist can visually add bulk to that area. The belt should be wrapped around the thinnest part of the waist for maximum slimming effect. Avoid belts with horizontal details as they will make the waist look bigger, whereas vertical detailed belts will draw the eye up and down.

If the shape comes in combination with a short neck and a fuller bust more skin around the neckline should be shown, e.g. with a low V-neck, scoop necks and wrap tops. They help slim down the chest and visually lengthen the neck. Stiff and shapeless garments should be avoided as they only emphasise the rectangular body shape. Straight styles, such as a straight sheath dress, can be worn with accessories, e.g. bold necklace, thin belt and eye-catching shoes to draw attention to the legs and face. Wearing jackets, sweaters and tops that are nipped at the waist helps to add definition to the waist. The nipped shape should be at the waistline or just below the bust – this helps to make the bust look bigger, pushed up and adds some weight on top, making the waist look smaller. Bust-enhancing necklines and designs help emphasise the bust and slim down the waist, e.g. scooped necklines and bustiers. Voluminous skirts are suitable as they will give a feminine shape, e.g. full circle cuts, pencil skirts that are stitched down at the side seams to add curves, panelled and layered skirts, A-line skirts, ruffled and tiered, ruched and gathered skirts are all suitable. Avoid too full or fluffy skirts as they make the figure bottom-heavy and create unbalance to the rectangular body shape.

2.5.5.5 Apparel styles and designs suitable for the oval body shape

This body shape is typically full-bodied with an oval appearance, especially in the torso area. The aim is to visually elongate the body and create an inverted triangular body type, for instance.

Single-breasted jackets in a boxy, blazer style are suitable. Over-blouses, tops and jackets worn at least to the hipline are ideal. Vertical lines and designs wherever possible, e.g. in tops and bottoms, help to slim the body as they move the eye up and down. Well-fitted bras, support garments for torso shaping with stocking are ideal. Straight and soft pants to

minimise bulk and tunic tops and dresses that flow through the waistline are suitable to avoid emphasising the folds and bulges.

2.5.5.6 Apparel styles and designs suitable for the diamond body shape

The mid-body is larger than the upper or lower body, giving it a diamond-like appearance. The aim is to create an optical illusion of a thin and lengthened torso by creating shoulder definition, camouflaging the wide, problem waistline. Emphasise the shoulder line with squared-off shoulder pads. Well-fitted bras are suitable to keep the bust high, for instance with a push-up bra. Straight or slightly tapered skirts and trousers, a one-piece dress without a waistline, and straight or flowing jackets all camouflage the wide waistline.

2.5.6 Techniques used for the classification of body shapes

Body shape and measurement data can be obtained through anthropometry, body scans and photographic images. However, it is evident from the literature that the body shape analysis (and consequent classification) is viewed from the perspective of various scientific disciplines. Sheldon (1940) used photographs to come up with three body types, while Douty (1968), Stunkard, Sorenson and Schulsinger (1983) and Singh (1993) used line drawings or silhouettes to classify shape. Minott (1978), Rasband (1994) and Armstrong (1995) used schematics or geometric shapes based on accumulated observation to classify the body types into whole or partial classifications (Connell, Ulrich, Brannon, Alexander & Presley, 2006). Body scan data is classified into the different body shapes using shape sorting software (Simmons, Istook & Devarajan, 2004b).

Body scans have been found to be more efficient, accurate and highly reliable in capturing the three-dimensional shape of the body. Despite the promise of more reliable data, in developing countries like Swaziland, the use of body scanners is still in the distant future due to the lack of financial and technical expertise. For purposes of this study, anthropometry, traditional tailors' methods and the mathematical shape definitions were employed to identify body shape.

2.5.6.1 Shape sorting software

Computer software has been developed to perform analysis of the scanned data to classify body shapes, e.g. the female figure identification technique (FFIT) and the body shape analysis scale (BSAS). A quest to develop shape-sorting software that could extract 3-D scan measurements and automatically determine the shape defined by those measurements

saw the birth of the female figure identification technique (FFIT) for software for apparel. The FFIT for apparel is based on the computation of selected girth measurements and the bust to waist, hip to waist and hip to bust ratios that are used to sort the body types into hourglass, top hourglass, bottom hourglass, spoon, rectangle, diamond, oval, triangle and inverted triangle shapes (Simmons, Istook & Devarajan, 2004b). The FFIT for apparel is more encompassing as it has a wider spectrum of body shapes to sort into.

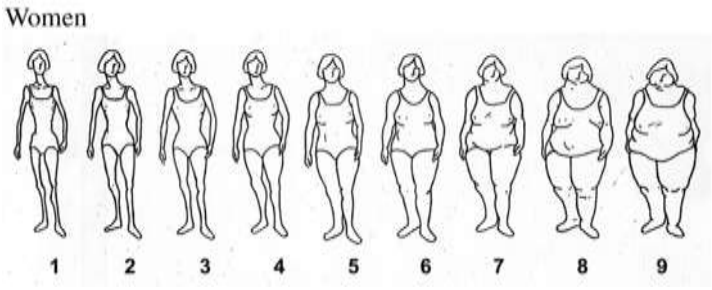
A body shape assessment scale (BSAS) which consists of nine separate assessment scales is used to sort or classify body shapes using scanned data. Four of the scales assess a front scan view of the female figure including body build, body shape, hip shape and shoulder slope, while the other five scales use a side scan view to assess the front torso shape, buttock shape, back curvature, posture and bust prominence (Connell, Ulrich, Woronka, Knox, Hutton, Bruner & Ashdown, 2003). The BSAS is based on the body build and posture scales established by Douty (1968), and categorises the body shapes into one of the following body shapes: hourglass, pear, rectangle and inverted triangle. It evaluates the front and side views of the body for characteristics of the body parts and the relationship of the body parts to the whole body. The Body Shape Analysis Scale (BSAS) uses the hourglass body shape as a reference point for body shape analysis and further identifies other relevant body areas key for proper fit of apparel.

2.5.6.2 Photographic and Silhouettes technique

In addition to the anthropometrical measurements, photographic measurements of the human body are employed, as they are more accurate in predicting angles (Kwong, 2004:205). Photographic data in the form of frontal and side view body pictures give profiles of the population being studied and aid in the identification of body types. Body landmarks plotted on these body profiles help to maintain dimensional and postural accuracy (Douty, 1968, cited by Simmons, 2002). Douty made ground-breaking contributions to understanding fit and sizing for women by developing graphic somatography, whereby a person's image was projected onto a lit translucent screen with a grid pattern in order to photograph front and side silhouette views. This approach of the Douty scales, which is the only existing graphic attempt at body shape analysis for apparel development and which was based on somatography, has been used by researchers and experts in fit; the concept behind the BSAS software is also based on this approach.

In his study, Sheldon (1940, in Salusso-Deonier, Markee & Pedersen, 1991) used the subjects' photographs to categorise body shapes, while Stunkard, Sorenson and Schulsinger

(1983) and Singh (1993) used silhouette figure drawings to classify and study shape (**Figure 2.35**).



Images 1 and 2 = underweight; images 3 and 4 = appropriate weight; image 5 = slightly overweight; images 6 and 7 = moderately overweight; images 8 and 9 = very overweight

FIGURE 2.35: SILHOUTTE FIGURE DRAWINGS USED TO CLASSIFY BODY SHAPES

Sheldon concluded that there were three primary components based on tissue layers which, when combined together, make up all physiques or somatotypes (**Figure 2.36**). These components were called endomorphy, mesomorphy and ectomorphy. In brief, the descriptions of each component are as follows: Ectomorphs are generally tall and thin and have long arms and legs, are more inclined toward leanness and are stoop-shouldered, which is the body type normally seen in runway models. A very small proportion of the population has this type of body. Mesomorphs are generally muscular, shorter, have stocky arms and legs, have a tendency towards muscularity, are rectangular-shaped and have an upright posture. Endomorphs are generally shaped like apples or pears and carry more body fat. They are more inclined toward plumpness and a round shape (Wells, 1983, cited by Simmons, 2002). Sheldon postulated that not every human being conforms precisely with one of these categories, but rather has characteristics of each, although one is usually predominant over the other body types. He suggested that people determine early in life as to which figure type they possess, before changes that are due to age and lifestyle affect the shape of the body.

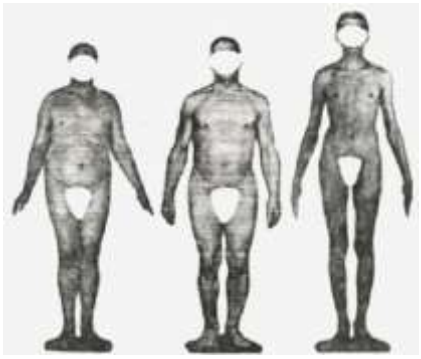


FIGURE 2.36: **THREE PRIMARY SOMATOTYPES** (Source: Sheldon, 1940, in Salusso-Deonier, Markee & Pedersen, 1991)

2.5.6.3 Observation technique

In pattern-making and clothing selection books, authors have typically used schematics to represent classifications of partial or whole body shapes based on accumulated observations (Minott, 1978; Armstrong, 1995; Rasband & Liechty 2006). Rasband identified common figure types based on observation and described figure deviations as physical features that differ from the ideal figure. She grouped figure types based on their geometric shapes into ideal, triangular, inverted triangular, hourglass, rectangular, tubular, rounded and diamond. She postulated that bone structure, height, weight distribution, body proportion, posture and contouring of the figure type are interrelated, i.e. one affects the other. Rasband however suggested that, once fully developed and if genetically ordered, the height, bone structure, body proportion and weight distribution remain constant.

Armstrong (1995) grouped female body shapes into the following four body shapes: ideal / hourglass, broad shoulders and small hips, narrow shoulders and large hips, and straight. She further classified hip types, shoulder types, bust shapes, posture and back types. Hutchinson and Munden (1978) also emphasised that the analysis of the back shape is vital in apparel fit and cited the comprehension of shoulder shape as crucial in determining the shoulder slope and forward angles of shoulders.

Though she did not classify the shape of the body as a whole, Minnot (1978) analysed and classified hip shape into heart, average, semi-heart, very little difference, diamond and rounded diamond. Minot proposed that the direct transfer of the body shape to the shape of the pattern would result in good fit. She integrated hip shape classifications with the drafting of basic skirt patterns, e.g. the difference between the waist and hip circumferences and the hip type determined the side seam shape on the basic skirt pattern.

2.5.6.4 Mathematical shape definitions technique

The female figure is not a simple figure and shows the relationship of its shape to apparel fit at various body sites. One technique in body shape analysis is based on mathematical modelling (Vuruskan & Bulgun, 2011). The criterion for body shape sorting is defined by mathematical descriptions whereby mathematical formulas are used to sort the figure types into the different shape categories. The underlying criteria used by the FFIT for Apparel to sort figure types into the different shape categories are also mathematical descriptions which may also be visually verified (Lee, Istook, Nam & Pak, 2007). Drop values of the bust, hip and waist in conjunction with body ratios of bust to waist, hip to waist and hip to bust, form the guiding principles on which the mathematical formulas are based. The decision as to which drop value and proportional ratios to use, is dependent on the body shape being identified.

The shape sorting process is done in a systematic manner to ensure that data is not sorted again after it has been categorised. The hourglass, apple and rectangle body shape use the bust minus waist drop value due to the fact that these shapes have a bust that is aligned to the hip. The waist is indented, with the exception of the apple shape which has a wider waist circumference. The hourglass is said to have a higher drop value compared to the rectangle shape. The triangle and inverted triangle shapes on the other hand employ the hip minus bust drop value, based on the fact that the triangular body shape has a bust that is smaller than the hips (Rasband & Liechty, 2006:24). The triangle body shape has positive drop values, while the inverted triangle has a bust that is wider than the hips, thus yields negative drop values. The established mathematical formulas for the different body shapes are as follows (Lee, Istook, Nam & Park, 2007):

Hourglass:
(bust – hip) ≤1 cm; (hip – bust) < 3.6 cm; (bust – waist) ≥ 9 cm or (hip – waist) ≥ 10 cm

Triangle:
(hip – waist) < 9 cm or (hip – bust) ≥ 3.6 cm

Inverted triangle:
(bust – waist) < 9 cm or (bust – hips) ≥ 3.6 cm

Rectangle:
(hip – bust) < 3.6 cm and (bust – hip) < 3.6 cm
(bust – waist) < 9 cm and (hip – waist) < 10 cm

2.6 BODY FORMS

Body forms are made from materials that give them life-like properties to ensure the best assessment of apparel fit. The three-dimensional shape, size and posture of body forms are exact conformations of individuals selected in the target market. To ensure this, prototype body forms are milled using approximately 300,000 3-D data points to maintain dimensional and postural accuracy and precision to produce body forms that represent real people (Yu, 2004a:35).

A silhouette may be developed on the body form by draping the fabric directly over it or a prototype of the garment may be fitted on the body form for fit evaluation. Pattern makers, fashion designers and manufacturers use body forms to ensure clothing fit. Accuracy and quality of apparel can only be realised through the use of dress forms, fit models and sizing systems that represent the target population's sizes and body shapes (Salusso-Deonier, 1989). On the contrary, body forms are built according to the shape and dimensions of fit models that have proportionate bodies – which are not common to all women – instead of their actual dimensions and shapes (Bougourd, 2007:131-132). The use of these body forms does not mean better fitting apparel as women have varied body shapes and proportions. It is therefore crucial that body forms are functional and represent the average size and shape of the target market. Body forms are either non-adjustable or adjustable and can then be adjusted to different sizes or body measurements; they may also feature neck and torso height adjustments. These body forms often have twelve adjuster dials to facilitate adjustments on the form to ensure perfect proportions and sizes, and to accommodate long or short waists and various neck sizes. The non-adjustable body forms have one size and body shape which cannot be adjusted. To compensate for shortcomings, the user often uses padding to cater for well-endowed body areas.

Some advances in the development of body forms have been seen in recent years. To reduce sample making costs, improve efficiency in production and increase accuracy in fit, based on 3-D human form and garment engineering, a company called Alvanon (www.alvanon.com) sells tailor-made body forms which are also used to assess garment fit. A series of new body forms that resemble the human body more than the conventional body form were developed by the Digital Human Laboratory in collaboration with the Bunka Fashion College in Japan (Yu, 2004a). These include Japanese forms, which, when compared with the traditional dress forms, it was noted that the Japanese armhole shape is a wonky triangle compared to the rectangular armhole in the conventional body form; hence it offers better fit to the front. The wonky triangle is said to give a better orientation of the arm,

thus rectifying the problem of the arm hanging straight down from the upright rectangle. The Japanese body forms slightly changes in shape and size every two years as all first-year students at the Bunka College are scanned and the moulding of the body forms is fed the averaged data of these new students. This is done to detect trends in body shape and size. Tuka forms were also produced; they feature precise anatomical detail and use a unique material that looks and performs like human skin. These body forms are constructed from 3-D scanned data of real-life fit models. CAD modelling provides a complete set of body forms called FORMAX, that represent real live models for the target populations for which the garments are intended. These body forms are developed based on all body conformations extracted from anthropometrical statistics obtained from a ScanFit system.

To address the fit problems associated with the rigidity of body forms, a patented fitting system has been designed to match every area of the body on a dress form and to give a more realistic view of how clothes will fit and feel. It has 14 contoured pads that address problem areas and filler pads that tuck underneath the contoured pads to increase the measurement if necessary. The pads are soft and contoured, and adhere to the body form under a tight stretch cover which tucks the pads at the vertical and horizontal measurement of that area. Focal body areas targeted to improve fit include the shoulder area (wide or sloping), the bust (vertically or horizontally), side back (for a wider back), upper hip, thighs and back hips (vertically and horizontally).

However, despite all these advances in the development of body forms, commercial garment standards are still unsatisfactory, as reflected in their limitations in terms of shape and size accuracy (Yu, 2004a:35). Body forms used by small-scale apparel manufacturers in Swaziland are generally sourced in South Africa, made in Taiwan for Singer and Siera, and also by Figure Forms, a South African company.

2.7 IMPLICATIONS FOR THE STUDY

From the review of the documented relevant literature on this subject matter it is apparent that fit is a multifaceted phenomenon which needs the attention of various stakeholders in order to be enjoyed by the differently shaped and sized Swazi women.

The main divide between sizing and fit seems to be a lack of a full comprehension of the consumers, expressed by the inconsistency and lack of any relevance to body measurements in size labelling, hence confusing to consumers. Manufacturers do not have

comprehensive feedback on how their merchandise fit their target market, as consumers react to poor fit in different ways, e.g. alterations, wearing the garment in spite of the poor fit, returning it or not buying the garment. Consumers base their perception of fit on various factors which may vary from one consumer to the next, e.g. culture, style, fashion, comfort levels and sizing systems are typically based on proportional sizing systems that do not reflect the variety of body shapes in the target market.

Very little scholarly research is related to the body shapes of Swazi women and its usefulness for sizing and apparel fit has been published. Furthermore, there is very little known (in terms of documentation) about the Swazi clothing industry, i.e. how body measurements are taken, and the problems they face with regard to body variation and problems with fit. In an attempt to investigate the development of new slopers for women with disproportionate figures and to propose a sizing category for the stratum of female consumers, 30 Swazi women were measured at the bust, waist and hip circumferences (Magagula & Zwane 2006).

The point of departure in comparing the body shapes of young Swazi women to those of currently used body forms would be to establish the existing and prevalent body shapes of Swazi women and those of the body forms. Despite the promise of efficiency and accuracy offered by the non-invasive use of 3-D body scanners in yielding anthropometric data, the traditional tailor's method and anthropometric techniques are currently the only reality for Swaziland due to the absence of this technology and technical expertise. A comparison of the body shapes, dimensions and proportions of young Swazi women and the body forms is of the essence in determining whether the currently used body forms enhance or hinder fit. This implies that a larger sample of women and a wider spectrum of measurements and dimensions should be used in this kind of study.

In Chapter 3, the specific research objectives, adopted research design and the methodologies that were employed in order to address the problem are discussed.

CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The primary purpose of this research was to determine a comprehensive profile of young Swazi women in terms of body dimensions, body proportions and body shapes in a bid to improve the shape and proportions of the body forms currently used, hence afford better fit in apparel for Swazi women.

3.2 CONCEPTUAL FRAMEWORK, PURPOSE AND OBJECTIVES

3.2.1 Conceptual framework

The conceptual framework (**Figure 3.1**) was developed against the backdrop of Ashdown's (2000) theoretical framework as it provided the background information for its development. Furthermore, the conceptual framework was designed in accordance with the objectives of the study. The concepts in the framework are interdependent and interact with one another, as each concept affects the usefulness of the other concepts, hence in defining one concept, reference is made to the other concepts.

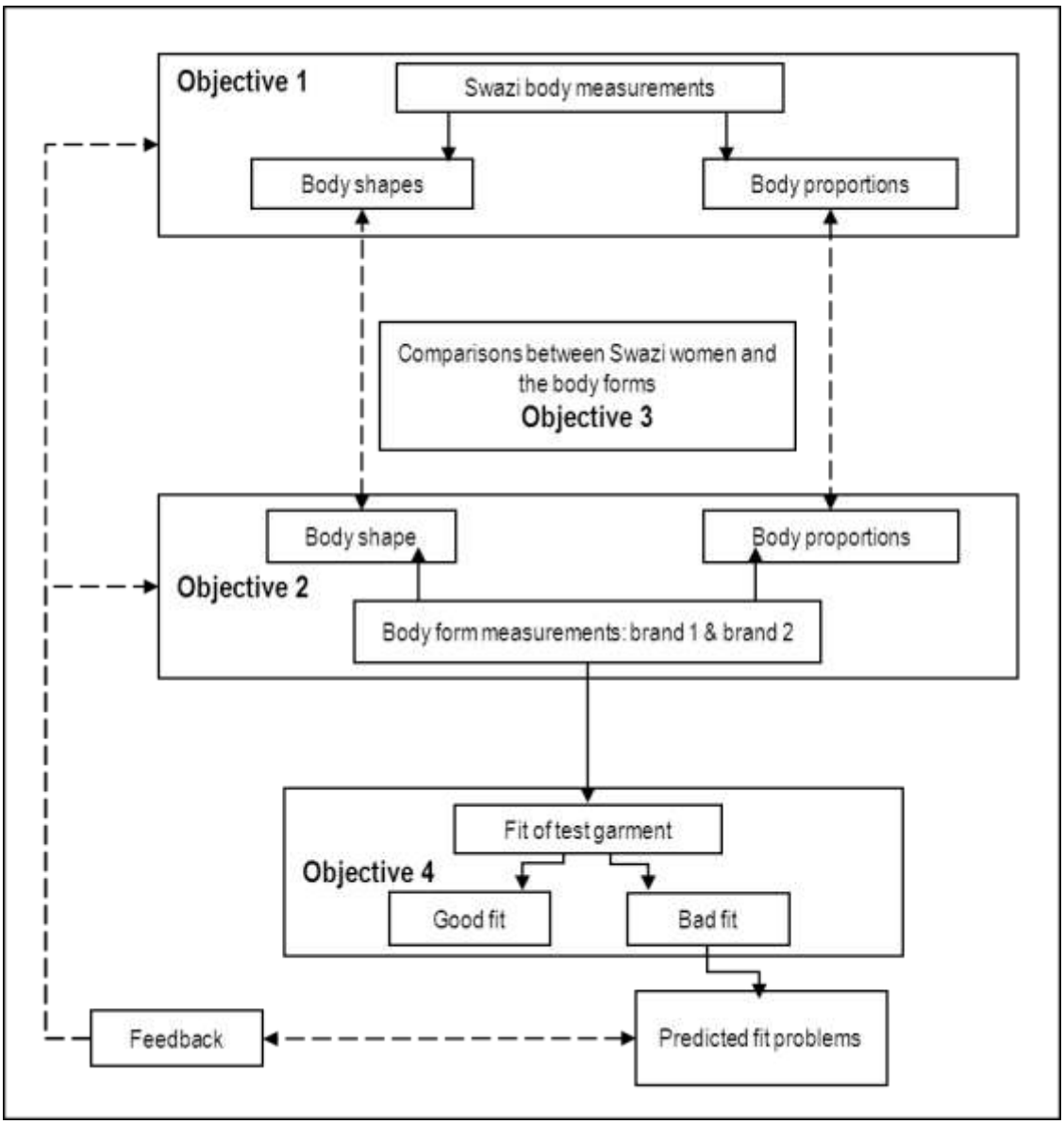


FIGURE 3.1: CONCEPTUAL FRAMEWORK

3.2.1.1 Body measurements

The body measurements are crucial aspects of the conceptual framework. Any change in the body measurements will trickle down and have an effect on all the other concepts in the framework, as reflected in **Figure 3.1**. Body measurements are fundamental in the identification of body shapes and body proportions, while fit problems cannot be addressed without a set of accurate body measurements of the Swazi population (Istook & Hwang, 2001). Without body measurements the test garment cannot be constructed for fit testing.

It is of the utmost importance that the anthropometric data is current and should be extracted from the relevant population, i.e. the Swazi population. The key dimensions, i.e. bust, waist

and hip girths, are critical as they are indicators of shape differences (Workman, 1991). In addition to the key dimensions or inflection points, other pertinent measurements that could aid in the identification of the body shape and body proportions of the Swazi women, compared to the body forms, were incorporated. Where and how the measurements were to be taken was well established, through the use of standardised procedures.

3.2.1.2 Body shape and body proportions

In order to achieve good fit it is necessary to identify and define size and shape based on a combination of key body measurements (Petrova & Ashdown, 2008). In an attempt to categorise body shapes, two main methods emerge: the use of proportions of the front and side profile widths (Connell *et al,* 2003) and the use of the proportions of body circumferences (Simmons *et al,* 2004a). Both these methods have merits, thus they were prudently merged to achieve the identification of the full/whole body. To have the benefit of both methods, a combination of circumferential proportions, body heights and lengths and widths and depths were considered for this study. Although the circumferential measurements of the body forms and of the Swazi women may be similar, the shapes may be quite different, thus require differently shaped garments to ensure good fit (Ashdown, 2003; Kwong, 2004:197). Body proportions amongst other factors (e.g. body posture and body symmetry) also affect the fit of clothing as a vast variation in the distance from the different body points will invariably lead to fit problems.

3.2.1.3 Test garment

The construction of a test garment facilitated fit testing on the body forms. In order to appreciate the five principles of fit, i.e. ease, line, grain, balance and set, ease was added to the pattern and the fabric was cut and sewn on grain. The body measurements of the Swazi women yielded the resultant body shapes and body proportions. Pattern blocks are conventionally drafted by using linear body measurements (Kwong, 2004:196), thus the pattern blocks were drafted using the body measurements of Swazi women. Wearing ease, i.e. the extra amount added to the body measurements to enhance body movement, drape and comfort, was added to the body measurements. The implication is that body measurements taken from another population other than the target population leads to the generation of basic patterns that may lead to fit problems. A two-piece toile dress *(bodice and skirt seamed at the waistline)* was used to construct a sleeveless, close-fitting two-piece dress block. The two-piece dress block facilitated an easier assessment of the positioning of the waistline in addition to the other key body dimensions. A seam allowance of 1.5 cm was used for all the basic seams, and no seam allowance was added to the armhole and

neckline. The basic toile facilitates easy assessment of fit without camouflaging the shape and proportions of the body.

3.2.1.4 Fit testing

Fit testing is an important aspect of the product development process in order to achieve well-fitting garments (Ashdown & O'Connell, 2006). Fit testing may be done on live models that have similar body measurements or on body forms. The focus of the study is a comparison of the shape of Swazi women to that of body forms; therefore fit was tested on body forms that are commonly used by the local small-scale manufacturers and represent the sizes included in the study, i.e. 32 and 34. The fit and comfort aspects have been shown to influence customer satisfaction with garments (Griffey & Ashdown, 2006). A fit scale for questions facilitates the determination of the level of fit and areas of fit problems, thus a fit scale of 9 was used to determine the level of fit. The questions in the fit checklist for the determination of fit concerned the overall fit based on the body measurements that were taken.

3.2.1.5 Fit problems

Fit problems are caused by a number of factors which are all rooted in the accuracy of anthropometric data. An inaccurate set of body measurements has repercussions that trickle down to all the other concepts in the framework and ultimately lead to fit problems. Feedback on fit problems experienced with garments made from body forms is helpful in addressing the problems. A clear understanding of how and where the measurements should be taken is crucial in ensuring accuracy of the body measurements. Inaccuracy of body measurements leads to the drafting of inaccurate pattern blocks, and ultimately ill-fitting garments.

3.2.2 Purpose of the study

The purpose of the study was therefore to determine a comprehensive profile of young Swazi women in terms of body dimensions, body proportions and body shape, in a bid to improve the shape and proportions of the body forms currently used, hence afford better fitting apparel for Swazi women.

3.2.3 Objectives of the study

Primary objective 1:

To identify and describe the most prevalent body shapes of young Swazi women through body dimensions.

Primary objective 2:

To identify and describe the body shapes of the currently used body forms through body dimensions.

Primary objective 3:

To describe and compare the most prevalent body measurements and proportions of young Swazi women to those of currently used body forms.

Sub-objective 3.1:

To analyse and compare the most prevalent body measurements and proportions of young Swazi women to those of currently used body forms (through measurements).

Sub-objective 3.2:

To investigate and determine whether there is a significant difference in body measurements and proportions of young Swazi women and currently used body forms.

Primary objective 4:

To test and evaluate the fit of the test garment which represents the size and most prevalent shape of the Swazi women, on the body forms.

3.3 RESEARCH STRATEGY, APPROACH AND DESIGN

This study was conducted using a quantitative methodological paradigm. The quantitative research strategy involves the collection and analysis of numerical data in order to explain, predict and control phenomena of interest. However, it entails more than just the use of numerical data as it must specify the research procedures that will be used to carry out the study, maintain control over contextual factors that might interfere with collected data, and

use enough participants/subjects to provide statistically meaningful data (De Vos *et al,* 2002; Gay, Mills & Airasian, 2006; Fraenkel & Wallen, 2006).

The study was explorative in nature as it helped to clarify a largely undefined area, namely body shape analysis of young Swazi women. Under the quantitative research strategy, the survey research methodology was used. Surveys are much quicker and reliable for enumerating characteristics within populations, usually producing rich and detailed outcomes (Fraenkel & Wallen 2006). A cross-sectional survey was conducted as the information was collected at one point in time, though the time it took to collect all the data was six weeks.

3.4 SAMPLING PLAN

3.4.1 Unit of analysis

The units of analysis were young Swazi female students from the University of Swaziland (Faculty of Agriculture) aged between the ages of 18 and 30 years, and female students from St Christopher's High School aged 18 years and above. Two brands of body forms that are commonly used by small-scale apparel manufacturers were used for comparison purposes. The researcher was able to have easy entry and develop rapport with students from the University of Swaziland as she already works for the University, hence cooperation and acceptance was smoother. Students from the University of Swaziland were used to represent young Swazi women as they come from all the geographical regions of the country and from varied socio-economic backgrounds. The University of Swaziland is the only University in the country. St Christopher's High school is a boarding school, hence the students also come from various parts of Swaziland.

A young woman is described as a female adult that is fully developed, aged between 18 years and 30 years for purposes of this study. At this age the young women are fully developed and have attained complete physical growth, full height, appropriate weight and an increase in size of all organs. Participants that are older than this age segment would have had figure variations correlated to their older age group. Studies on body measurements of elderly women report increased weight and decreased height, and an increase in girth measurements in the bust, waist, abdomen and hips due to fat deposits around these body areas (Patterson & Warden, 1984; Goldsberry *et al,* 1996). The sample represents a segment of society that shows high interest in fashion and apparel. Both high school female students and University female students are exposed to fashion, hence they

are fashion conscious. They respond to the appeal of fashion as they are at a stage where image is of the essence in the way they dress. The University students have the financial muscle in the form of government allowances to respond to fashion, as they are all sponsored by the Government of Swaziland, while the parents of high school students buy only what the students find fashionable and appealing.

Women often experience fit problems with ready-made apparel, evident in their spending much time trying on many styles and sizes, as their body shapes are varied due to a number of factors (Anderson *et al,* 2001). The under-bust sizes 32 and 34 were used to ensure that the data would be manageable.

3.4.2 Sampling procedure

The University of Swaziland has eight faculties spread over three campuses. However, due to time constraints and convenience at the time of the research, it was not possible to study all the young Swazi female students at the University of Swaziland. The study was consequently limited to the Faculty of Agriculture. The sampling frame, i.e. the total number of young Swazi women currently at the Faculty of Agriculture, is three hundred and thirty one (331) female students. In surveys, fieldwork often focuses attention on interactive social units such as social relationships and encounters, and is thus much less compliant to probability sampling techniques. Convenience and availability by and large determine where the researcher can begin to make observations (Singleton & Straits, 2005; Baker, 1999:135). To achieve a representative sample for sizes 32 and 34 and reduce bias, purposive non-probability sampling was employed for this study, hence the total population was identified using a non-random technique. A list of all the Swazi female students in the Faculty of Agriculture was obtained from the Faculty tutor's office. All the students on the list were approached and asked to indicate their bust sizes as it was one of the prerequisites for inclusion in the study. Out of the total population of female Swazi students only those that indicated a bust size of 32 or 34 were to be included in the study. All the students who had a bust size of 32 or 34 were included in the study to ensure that there were enough participants to provide statistically meaningful data. The researcher deliberately identified the criteria for selecting the participants as it provided the basis for inclusion in the study. To reduce sampling error, a large sample of 101 women were measured. With regard to the body forms, only one size 32 and one size 34 were measured for each body form brand, because there can be no variation in the shape and proportions.

3.4.3 Limitations of the sample selection criteria

The initial plan for inclusion into the study was a mere indication by the participants that they wore a size 32 or 34, and the total population of the students who indicated to be a size 32 or 34 were included in the study. After data collection it was however noted that about 50% of the participants who had indicated that they were a size 32 or 34 were actually a size 36 or above when their individual under-bust measurement was compared with the retail standard under-bust measurements. The issue of body image and body cathexis had been overlooked; yet body image (which is the perception of a person's own body) (Fan, 2004:8) is said to influence unconscious factors such as attitudes and wishes. The self-perception of a high percentage of women is said to be skewed towards dissatisfaction, hence some women may consciously wish for a slimmer body or may unconsciously perceive themselves to be slim. Body cathexis on the other hand refers to the evaluation of body image and self-concept. It is highly correlated to satisfaction with clothing fit (Fan, 2004:10). This might have prompted the young women to perceive themselves as being a size 32 or 34, whereas in actual fact they fell within a bigger size bracket. It was therefore decided to remove all the data collection forms which had recorded sizes that did not match the retail standard under-bust size measurements, as this would have influenced the results of the study.

3.4.4 Re-strategizing of the sample selection criteria

Since the University of Swaziland had closed for its long vacation and due to time constraints, the researcher decided to identify female students aged 18 years and above from a nearby boarding high school who fitted the targeted size profile. This required the researcher to seek permission from the school's Head Teacher to carry out the measuring exercise at the school. An appointment was made with the Head Teacher where the aim, objectives, measuring exercise and possible benefits of the study were explained. Verbal permission was granted and the assistance of one class teacher was offered to identify the girls aged 18 years and above from the class registers. To avoid any further surprises, the researcher measured the under-bust dimension for all the girls that were aged 18 years and above. Only those that fell within the size 32 and 34 under-bust retail standard measurement bracket were included in the study.

3.5 DATA COLLECTION

For objectives 1 to 3, data was collected from two categories of young Swazi women (University and high school students aged from 18 years to 30 years) and body forms (two brands). The total population of young Swazi women from the University and high school who met the criteria stipulated for inclusion in the study were included. The researcher obtained two commonly used body form brands from small scale apparel manufacturers which were measured to obtain the measurements for the body forms i.e. a size 32 and a size 34 in each body form brand. The data was collected through anthropometrical techniques and recorded in data collection forms (see **Addendums B & C**).

For objective 4, two test garments in sizes 32 and 34 were constructed using the body dimensions for the most prevalent triangular body shape of young Swazi women. A fit test session was held during which each of the body forms were fitted with the appropriate size test garment. The evaluation of fit was done by three experts in apparel design and construction, and recorded in fit assessment forms (see Addendum E).

3.5.1 Measuring protocol and preparations for the measuring exercise

The researcher made arrangements to meet all the prospective participants, i.e. those that were a size 32 or 34. During this meeting the participants were briefed about the purpose and importance of the whole exercise and how it would be executed, i.e. what each participant was expected to wear. It was explained why and which measurements would be taken and when the measuring exercise would begin.

Before the measuring exercise commenced, the participants were given a consent form (see **Addendum A**), which they read and signed before participating in the study. Prior to the measuring exercise it was explained to the participants that participation was on a voluntary basis. To ensure that the participants did not feel coerced into participating and for ethical reasons, it was further explained that if, at any point of the measuring exercise, one of them felt uncomfortable and wanted to discontinue with the exercise, she could freely do so at any given time.

To ensure privacy, the measuring sessions took place in a quiet room, without the presence of an unnecessary audience. To ensure consistency and uniformity, the participants were provided with a two-piece, light grey body suit that clung snugly to the body without restriction. The light grey colour was chosen as it would create no optical illusion on the size

and shape of the participants. The participants chose a suitable size that was not too restricting or too loose; it was worn over their undergarments, as the participants undressed and remained in their undergarments. As participation was on a voluntary basis, the participants were given a small token of appreciation in the form of a lunch voucher to be used at the University refectory after the measuring session. For ethical reasons, the body suit was worn only once by a participant, then laundered and repackaged, before it was used by another participant. Each participant was given an identification number to ensure confidentiality and to ensure that the results could not be traced back to the participants.

In 1996 Alison Beazley carried out a study in which measuring methods for an anthropometric survey of young women are well outlined (Beazley, 1996:55), with the aim amongst others of explaining to those in industry, retail or education how to undertake a small-scale body measuring survey. In addition to Beazley's study, direction was sought from other sources of literature including anthropometry books and international anthropometric standards (Bougourd, 2004; ISO 8559; Johnston, 2004; Lohman *et al,* 1988; Rasband & Liechty, 2006). This body of literature served as a guideline for undertaking the survey as this present study sought to determine body measurements for young Swazi women by undertaking a small-scale body measuring survey.

3.5.2 Body landmarks

To ensure that the body measurements were taken consistently and at the appropriate areas of the body, and that all horizontal markings clearly intersected all vertical markings, it was important to landmark the body before the measuring exercise was executed. The landmarks were identified through reliable standard techniques and were positioned on the participants in the following areas, as stipulated in Beazley (1996) and Bougourd (2004). In **Figure 3.2** the views of the landmarks that were used for this study are presented.

		
Front view	Side view	Back view

FIGURE 3.2: BODY LANDMARKS USED FOR THE STUDY

3.5.2.1 Neck/nape (7th cervical vertebra)

The subject assumed a relaxed position, with the hands hanging at the sides and the head in the Frankfort plane position. The landmark was identified by bending the neck forward and lowering the chin as it becomes conspicuous when the head is lowered. This position was marked with an adhesive sticker that has a hollow at the centre at the prominent vertebra at the top of the spine (Beazley, 1996; Bougourd, 2004). This landmark was used for the nape to back waist and the centre back neck point to breast/bust measurement.

3.5.2.2 Shoulder point (acromion)

The subject assumed a relaxed position with the hands hanging at the sides and the head in the Frankfort plane position. The acromio-clavicular joint positions on the right and left sides were determined by palpating along the spine of the scapula to the corner of the acromion. Landmarking was done with the central hole of the adhesive sticker at the mid-points of the acromion (McConville, Tebbetts & Churchill, 1979, in Simmons & Istook, 2007; Bougourd, 2004; Beazley, 1996). The shoulder landmark was used for the back shoulder width measurement.

3.5.2.3 Shoulder neck point

The subject assumed a relaxed position with the hands hanging naturally at the sides and the head in a Frankfort plane position. Landmarking was done with the central hole of adhesive stickers placed below the earlobe at the base of the neck, at the side where the neckline meets the shoulder line. This landmark was used for the neck base girth and the nape to bust point measurements.

3.5.2.4 Clavicles and centre front neck point

The subject assumed a relaxed position with the hands hanging naturally at the sides and the head in a Frankfort plane position. Firstly the neckline was identified with a short chain that settled comfortably, just below the slight hollow at the base of the neck. Landmarking was done with the central hole of adhesive stickers placed at the prominent clavicles and at the exact centre front of the neckline. These landmarks were used for the neck base girth measurement.

3.5.3.5 The breast tips/bust level

The subject assumed a relaxed position with the hands hanging at the sides and the head in a Frankfort plane position. Landmarking was done with the central hole of adhesive stickers placed at the breast tips. This landmark was used for the bust girth, the width of bust prominence and the nape to bust point measurements.

3.5.2.6 Waist

The subject was asked to bend sideways, thus creating a slight indentation at the sides, which enabled the location of the waistline. The subject then assumed a relaxed standing position with the arms folded across the thorax and the head in the Frankfort plane position. The landmarks were located and marked by means of adhesive stickers with the central hole placed at mid-points of the natural waist indentation at the sides, small of back waist, and front waist *(about 4 cm above the navel)*. This landmark was used for the waist girth, nape to back waist and the bust to waist measurements.

3.5.2.7 Abdomen

The subject assumed a relaxed standing position with the arms folded across the thorax and the head in the Frankfort plane position. The landmarks were located and marked by means of adhesive stickers with the central hole placed at the fullest part of the abdomen. This landmark was used for the lower waist girth measurement.

3.5.2.8 Hip (trochanterion)

The subject assumed a relaxed standing position, with the arms folded across the thorax and the head in the Frankfort plane position. The position was identified by palpating the lateral aspect of the gluteal muscle, up and down with the heel of the hand, until the superior surface of the hip bone (trochanter) could be felt when strong downward pressure was applied. The landmarks were placed at the sides and maximum posterior prominence of the buttocks. This landmark was used to aid as a point of reference for the hip girth and the back waist to hip measurements.

3.5.2.9 Lower hip

The subject assumed a relaxed standing position, with the arms folded across the thorax and the head in the Frankfort plane position. The landmarks were located and adhesive stickers were placed with the central hole at the maximum prominence at the side of the body at the lower hip. This landmark was used to aid as a point of reference for the lower hip girth measurement.

3.5.2.10 Trunk line

The subject assumed a relaxed standing position with the arms folded across the thorax and the head in the Frankfort plane position. The ears' hole served as the head's landmark, while the shoulder, armpit, natural waist indentation, hip and lower hip landmarks served as guideline for the trunk line. The landmarks were marked by means of adhesive stickers and were used to aid as a point of reference for the waist height, hip height and shoulder height.

3.5.2.11 Armpit (axilla) level

The subject's hands were raised and the head was held in the Frankfort plane position. Landmarks were placed on either side at the mid-points of the hollow armpit area at the sides of the body. The body was marked with adhesive stickers with a central hole. This landmark aided in the measurement of the bust extension and bust measurements.

3.5.3 Body measuring instruments

A vast body of literature sourced from ISO (1989), Simmons and Istook (2007), Lohman *et al,* (1988) and Beazley (1996) served as a point of departure in the decision-making process of which measuring tools to use for this study. Ultimately, the following measuring tools were

deemed appropriate for the measuring exercise. The measuring equipment used for the study is presented in **Figure 3.3**.

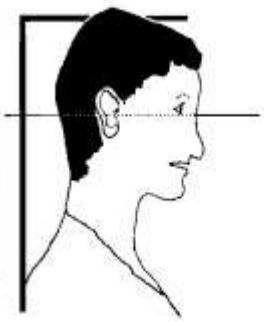
			
Anthropometer	**Digital weighing scale**	**Chain, elastic tape, adhesive stickers, segmometer and stature meter**	**Frankfort plane position** (Source: www.scotland.gov.uk)

FIGURE 3.3: BODY MEASURING EQUIPMENT AND FRANKFORT POSITION USED FOR THE STUDY

3.5.3.1 Metal tape measure

A dimensionally flexible but stable metal tape measure of approximately 10 mm wide graduated in millimetres was used for all the girth and contour measurements.

3.5.3.2 Anthropometer

Due to the unavailability of an anthropometer, an improvised anthropometer was used. It is a measuring stand that consists of a measuring tape that is vertically mounted and with three movable cursors that are positioned at right angles with the vertically mounted measuring tape and is graduated in millimetres. The improvised anthropometer was made according to the specifications as denoted in ISO (1989) under “Apparatus”. It was used for measuring all the vertical linear measurements. A stature meter was used in conjunction with the anthropometer for the height measurement.

3.5.3.3 Segmometer

A segmometer was used to measure the bust extension and the buttock extension.

3.5.3.4 Digital weighing scale

A digital weighing scale was used to determine body weight. It was calibrated before each use to ensure an accuracy of 1%, as stipulated in ISO (1989).

3.5.3.5 Chain

The chain was a fine metallic chain and it was used for measuring the neck girth in conjunction with a transparent 50-cm ruler.

3.5.3.6 Elastic tape

An elastic tape was used for the identification of the natural waist. During the landmarking exercise it was positioned on the indented waist side when the participant was bent sideways.

3.5.3.7 Landmarkers

The land-markers were in the form of white adhesive stickers that were hollow at the central region. They were positioned on the specified positions for the different landmarks.

3.5.4 Body measuring method and procedures

Traditional Anthropometric techniques were employed, as there are no digital scanners in Swaziland. Measurement of the human body has been used throughout history to estimate body shapes and proportions, and has produced reliable results (Lohman *et al,* 1988:97; Beazley, 1996; Bougourd, 2007; Yu, 2004c).

The measuring area was set up in such a way that it allowed a smooth progression of the measuring session as arranged in the data collection form. One of the issues that were addressed after the dry run of the measuring session, was ensuring that there was a smooth flow from one measurement to the next by arranging the equipment as per the need. The participants were requested to undress, remove their shoes and remain in their undergarments. Those that did not comply with the type of bra requisite were requested to wear an unpadded bra that fitted well, was made of thin material and did not contain metal or other supports. If necessary, participants were given a bra that fitted this requirement (ISO 1989).

The body was landmarked with adhesive circles with a hollow centre as they were easy to remove after the measuring process (Beazley, 1996). For circumference measurements, the plane of the tape around the body was held perpendicular to the long axis of that part of the body. In addition, for measurements taken while the subject was in a Frankfort plane position such as the bust, waist, hip, and abdomen measurements, the plane of the tape was parallel to the floor (Lohman *et al,* 1988:40). The Frankfort plane position is an imaginary line passing through the external ear canal and across the top of the lower bone of the eye socket, immediately under the eye (see **Figure** 3.3). This position is important if an accurate reading is to be obtained as the human head is said to be in a normal position and parallel to the floor at this position. The measuring tape was held snugly around the body part, but not too tight so as to avoid compressing the adipose tissue, thus indenting the skin. The tension applied to the tape by the measurer and the positioning of the tape measure affects the validity and reliability of the measurements, so the researcher and recorder were as consistent as possible throughout (Lohman *et al,* 1988:40; Beazley, 1996; Johnston, 2004).

The researcher took each measurement three times, and called them out to her assistant, who also loudly called out the measurement to confirm that it was correct, so as to ensure and maintain consistency and reduce error before recording (Beazley, 1996; Lohman *et al,* 1988:1). The research assistant was a Consumer Science student who has a background in taking body dimensions – a skill she gained in her apparel design and construction course and community nutrition course. The research assistant was further trained by the researcher on how all the measurements in the data collection form would be taken, and her role in the whole exercise was explained as she assisted with recording the measurements and aligning the tape measure at the back when girth measurements were taken.

Handedness has been found to influence some anthropometric dimensions as in some studies the right-hand side of the human body has been found to be larger than the left side, though this has not been found to have significant influence with regard to the purpose of the anthropometric studies. However, for that reason the body measurements were taken from one side of the body; the choice of which side is more suitable depends on the researcher as it is not significant (Lohman *et al,* 1988:91). For purposes of this study the right side of the body was used. The data was collected and recorded in data collection forms that were categorised into three sections to enhance the efficiency of the measuring exercise, i.e. vertical measurements, horizontal measurements, and girth or circumferencial measurements (see **Addendum B**).

3.5.5 Selection of measurements

A body form is used to create patterns and test the fit of different garments; the key dimensions chosen should therefore cover the scope of apparel that employs the benefits of body forms (Yu, 2004a:31). For purposes of this study, the key body dimensions were selected in view of the fact that the study seeks to analyse the shape and proportions of young Swazi women and of the currently used body forms in a bid to improve the shape and proportions and ultimately the fit of body forms. This study was limited to linear measurements, i.e. lengths and heights and circumferences, as it employed anthropometry which is limited in capturing body angles. Only the measurements that are relevant to the body forms and critical to the fit of apparel were selected. The selected measurements provided useful information in relation to body shapes and proportions which is congruent with the purpose of the study. To understand human variation in shape, size and proportions, specific segment lengths and circumferences are of critical importance (Lohman *et al,* 1988:9; Beazley, 1996; Rasband & Liechty 2006; Bougourd, 2007). After a thorough review of the relevant literature, in addition to the basic key body dimensions, that is the bust, waist and hip, other body dimensions were included to help identify the body shapes and proportions of young Swazi women and body form torsos; thus a total of twenty three (23) measurements were taken per participant.

3.5.6 Measuring technique

The techniques or procedures and the equipment used for taking the measurements are presented in **Table 3.1**.

TABLE 3.1: AN OUTLINE OF THE MEASUREMENTS THAT WERE TAKEN, EQUIPMENT, MEASURING TECHNIQUE OR PROCEDURE USED FOR TAKING BODY MEASUREMENTS

Measurement	Equipment	Measuring technique
Height and vertical measurements		
Height (stature) (ISO8559 2.2.1)	Improvised Anthropometer and Stature metre interchangeably	The measurement was taken on the vertical distance between the crown of the head and the standing surface (ground). The subject stood erect with the head in Frankfort plane, heels were together without shoes, with the weight distributed equally on both feet.
Nape to ground (ISO8559 2.2.12)	Improvised Anthropometer and Stature metre interchangeably	The subject stood upright with the head in Frankfort plane, heels were together without shoes, with the weight distributed equally on both feet. The measurement was taken between the distance from the 7th cervical vertebra to the standing surface (ground).
Shoulder to ground	Improvised Anthropometer and Stature metre interchangeably	The subject stood upright with the head in Frankfort plane, heels were together without shoes, with the weight distributed equally on both feet. The distance was measured vertically from the acromion to the ground.
Natural waist to ground (ISO8559 2.2.3)	Improvised Anthropometer and Stature metre interchangeably	The subject stood upright with the head in Frankfort plane, heels were together without shoes, with the weight distributed evenly on both feet. The measurement was taken between the natural waist level and the ground at the side of the body.
Hip to ground (ISO8559 2.2.4)	Improvised Anthropometer and Stature metre interchangeably	The subject stood upright with the head in Frankfort plane, without shoes, and the feet were together. The weight was distributed equally on both feet. The measurement was taken from the trochanteric projections to the ground.
Centre back neck point (nape) to waist – contoured (cervical to waist) (ISO8559 2.2.10)	Metal tape measure	The subject stood in a relaxed position with her back to the measurer. The measurement was taken between the centre 7th cervical vertebra (back neck point) and the waist level. It was measured on the contour of the centre back.
Centre back waist (natural) to hip	Elastic tape on the waist, metal tape measure	The subject stood in a relaxed position, the arms at the sides and feet together. With the subject's back facing the measurer, the measurement was taken vertically between the waist and the centre back hip landmark.
Centre back neck point to breast point (ISO 8559 2.2.13)	Metal tape measure	The subject stood in a relaxed position, the arms at the sides and feet together. The measurement was taken from the centre back neck point (7th cervical vertebra) through the right shoulder neck point (neck base) to the maximum prominence of breast point (nipples).
Bust to waist	Metal tape measure	The subject stood facing the measurer in a relaxed posture, with the arms at the sides and feet together. A metal tape was positioned vertically from the breast point then straight to the waist on the elastic tape.
Horizontal (girth) measurements		
Neck base girth (ISO8559 2.1.3)	Chain and the metal tape measure	The subject stood upright with the head in Frankfort plane, heels were together without shoes, with the weight distributed evenly on both feet. The measurement was taken over the base of the 7th cervical vertebra, the neck shoulder points and the medial superior borders of the left and right clavicles.
Bust girth (ISO8559 2.1.8)	Metal tape measure	The subject stood with her back to the mirror and facing the measurer. The measurement was taken over the maximum circumference across the shoulder blades, under the armpits and across the bust points, while the measurer checked in the mirror that the tape was placed correctly across the back scye level.
Under-bust girth (normal) (ISO8559 2.1.10)	Metal tape measure, elastic tape around torso under the bust	The subject stood with her back to the mirror, facing the measurer. The measurement was taken over the under-bust level during normal breathing. It was the circumference of the body immediately below the breasts. The measurer checked in the mirror that the tape was correctly positioned across the back.
Natural waist girth (ISO8559 2.1.11)	Metal tape measure and elastic tape	The subject stood erect with the abdomen relaxed, the arms at the sides and the feet together. The subject stood facing the measurer with her back to the mirror. The subject bent sideways to identify the natural indentation of the waist, then an elastic tape was placed around the subject at the natural waist level between the top of the hip bones and the lower ribs in a horizontal plane. The measurement was taken at the end of a normal expiration. The metal tape measure was held firmly, without indenting the skin, around the waist level. The measurer checked in the mirror that the correct back waist level was maintained.

Measurement	Equipment	Measuring technique
Lower waist girth	Metal tape measure	The subject stood erect with arms at the sides and feet together, with her back to the mirror. The measurement was taken at the end of a normal expiration. The metal tape was placed around the subject's abdomen below the navel The metal tape measure was held firmly, without indenting the skin and the measurer checked in the mirror that the tape was not placed over the buttocks.
Upper hip girth	Metal tape measure	The subject stood erect with arms at the sides and feet together, with her back to the mirror. The measurer stood at the side of the subject so that the level of the maximum extension of the buttocks could be seen. A metal tape was placed just above the buttocks in a horizontal plane above the hip level without compressing the skin. The recorder helped to position the tape measure on the opposite side of the subject. The metal tape measure was held firmly while the measurer checked in the mirror that the back level was correct. (If required, the subject held the tape in position.)
Hip girth (ISO8559 2.1.12)	Metal tape measure	The subject stood erect with arms at the sides and feet together, with her back to the mirror. The measurer stood at the side of the subject so that the level of the maximum extension of the buttocks could be seen. A metal tape was placed around the buttocks in a horizontal plane at the hip level (hip joint). The recorder helped position the tape measure on the opposite side of the subject. The metal tape measure was held firmly over the hip level landmarks at the centre front, centre back and left and right sides. The measurer checked in the mirror that the back level was correct. (If required, the subject held the tape in position.)
Lower hip girth	Metal tape measure	The subject stood with arms at the sides and feet together, with her back to the mirror. The measurer stood at the side of the subject so that the level of the maximum extension of the buttocks could be seen. A metal tape was placed around the buttocks in a horizontal plane at the greatest lateral trochanteric projections, without compressing the skin. The recorder helped to position the tape measure on the opposite side of the subject. The metal tape measure was held firmly over the hip level landmarks at the centre front, centre back and left and right sides. The measurer checked if the position of the tape at the back level was correct in the mirror.
Width and length measurements		
Back shoulder width (across back shoulders) (ISO8559 2.1.5)	Metal tape measure	The subject stood with her back to the measurer and arms hanging naturally. The measurement was taken between the acromion extremities, i.e. the left and right long shoulder landmarks. (*It is the shortest distance between the back shoulders.*)
Back width (ISO8559 2.1.6)	Metal tape measure	The subject stood in a relaxed position with her back to the measurer and arms hanging naturally. The measurement was taken across the back, halfway between the upper and lower scye levels.
Across chest at the front (midway between neck base and the scye level)	Metal tape measure	The subject stood in a relaxed position facing the measurer. The measurement was taken across the chest, halfway between the neck base (clavicles) and the lower scye levels.
Bust width (width of bust prominence) (ISO 8559 2.1.9)	Metal tape measure	The subject stood erect facing the measurer, with the arms at the sides, feet together and her back to the mirror. The measurement was taken horizontally between the bust points (nipples).
Bust extension	Segmometer	The subject stood upright in a Frankfort plane, without shoes and feet together, with one arm stretched forward. The measurement was taken from the trunk line (side) to the breast tip.
Buttock extension	Segmometer	The subject stood upright in a Frankfort plane, without shoes, feet together and shoulders relaxed. The measurement was taken from the trunk line at the hip joint to the end of the buttock extension.

(Sources: ISO 8559; Beazley, 1996; Bougourd, 2007)

3.5.7 Evaluation of fit

Consumers have specific expectations about the fit of clothing and can evaluate the fit of clothing at the point of purchase to determine satisfaction. Fit may be defined as the way a clothing item conforms to the body, or the relationship between the clothing item and the body, i.e. the garment must be comfortable or must have enough room for movement for a specific purpose (Yu, 2004a; Ashdown & DeLong, 1995; Workman & Lentz, 2000). The five principles of fit, i.e. balance, set, ease, line and grain, are foundational in the evaluation of fit. For purposes of this study, the same test garment was fitted on two different body form brands of the same size, thus the shape and size of the body form brand potentially influenced the fit of the test garment. In an effort to embrace the principles of fit and control tampering with the fit, the patterns were placed and cut on true grain, appropriate amounts of ease were added and the test garment was sewn using a cotton fabric that has no degree of stretch.

3.5.7.1 The development of pattern blocks

As mentioned above, a body form is used to create patterns and test the fit of different items of apparel (Yu, 2004a:35). Basic pattern blocks were therefore developed by the researcher for purposes of constructing a test garment that was then used for testing fit on the two brands of body forms. A bodice basic block and a skirt basic block for sizes 32 and 34 were drafted using the body dimensions of the most prevalent triangular shape of young Swazi women. The patterns were drafted using the pattern development procedure as outlined in Rosen (2004:34-44). A seam allowance of 1.5 cm was used for all the basic seams and no seam allowance was added to the armhole and neckline.

Ease is added to the body measurements to enable a garment to fit and hang well on the body. Ease refers to the measurable difference between the body measurements and the measurements of the garment (Rasband & Liechty, 2006:31; Myers-McDevitt, 2004:331). To emulate a human being, wearing ease was added to the body measurements to facilitate movement, breathing and comfort. Design ease was not considered for purposes of this study as the test garment was a basic toile that had no design features. The appropriate amount of ease is dependent on the design, the fabric, size and shape of the figure being designed for (Rasband & Liechty, 2006:36). The pattern designer's and manufacturers' common practice often determines the amount of ease to add or it is calculated as a percentage of the circumferences in a relaxed state, which removes the size dependence aspect. For purposes of this study, 1.25 cm was added to the bust, waist, hips and across the back measurements. The amount of ease added was guided by the table on ease

allowance (see **Addendum F**) by Myers-McDevitt (2004:332) and common practice. The least amount of ease suggested was used to avoid excess fabric that would tamper with the measurement comparisons and the fit of the test garment. The basic blocks *(bodice and skirt)* were used to cut and construct a calico sleeveless close-fitting two-piece dress. The two-piece dress was chosen because such a garment facilitates an easier assessment of the positioning of the waistline in addition to the other key body dimensions.

3.5.7.2 Preparation of body forms

The body forms were prepared for the fit testing session by attaching a tape at the bust-line, waist-line, hip-line and princess line. White adhesive stickers that are hollow at the central region were used to landmark the body forms at key body positions to aid the fit evaluation process.

3.5.7.3 Fit evaluation process

Visual analysis was used to evaluate and determine the fit of the test garments on the body forms. The fit assessment was subjective by nature, as a number of factors could have been at play, e.g. the evaluator's skills, state of mind and personality. The researcher therefore sought to ensure the reliability and validity of the whole fit assessment exercise by taking into consideration the skills of the evaluators, the assessment scaling, the assessment procedure and the analysis of the data collected. Thus three evaluators who are experts in apparel design and construction were used for the evaluation of fit to enhance the reliability of the assessments. Each evaluator independently completed a fit assessment form (see **Addendum E**) regarding the fit of the test garment on the body forms. Each body form was assessed twice to control measurement error and the average was used. A set of fit standards (see **Addendum D**) were used as guiding principles for the evaluation of the fit of the test garment. A fit assessment form (see **Addendum E**) was used to collect data and the scale for questions about fit had increments from 1 to 9. A score of 1 indicated a loose/long fit, while a score of 5 indicated a perfect fit, and 9 indicated a tight/short fit. The fit assessment form included only the standard dimensions that are needed when drafting and those that have design implications, i.e. nape to natural waist, natural centre back waist to hip, nape to bust point, bust point to waist, bust girth, waist girth, lower hip girth, across shoulders, back width, across chest, width of bust prominence, bust extension and buttock extension.

The three evaluators had differences in some of the evaluation scores, which necessitated that they reach an agreement on the final score to award. A difference of more than 1

between the scores for the three evaluators was deemed wide and hence called for re-evaluation by all the evaluators and an agreement on the score to be reached by the evaluators.

3.8 DATA ANALYSIS AND OPERATIONALISATION

3.8.1 Data preparation for analysis

According to Gay, Mills and Airasian (2006), collected data must be accurately coded and systematically organised to facilitate data analysis. The researcher made sure that all the data collection forms were fully completed, after which the data was coded, captured and systematically tabulated into summary data sheets to facilitate easier examination and analysis. When coding the data, non-numerical or categorical data was given codes and each participant was given an ID similar to the one in the data collection form. However, during data cleaning and management, some mistakes and errors were identified. These were managed and cleaned up by comparing the captured data with the completed body measurement forms, using the subject numbers to ensure that the corrections were from the right data form.

3.8.2 Data analysis

The SAS V9.2 software was used to analyse the data for the body shape classifications and summary statistics. Appropriate descriptive statistics in the form of means, standard deviation, frequencies and percentages were used. The study sought to identify and describe the most prevalent body shapes of young Swazi women and to compare them with those of body forms currently used. Drop values were used to identify the body shape groupings. The hip minus bust drop values were used to identify the triangle and the inverted triangle, while the bust minus waist drop values were used to identify the rectangle, apple and the hourglass shape.

The BMDP software was used to determine whether significant differences existed between the body proportions of Swazi women and those of two brands of body forms. The underlying parameter of the t-test, i.e. the assumption that the sample was drawn randomly from a normal population with equal variance, did not hold true for this study. For that reason, the Wilcoxon non-parametric t-test was appropriately used as the scale of measurement was also nominal, i.e. numbers with no implied order were used as labels. For purposes of

interpretation of the findings, probability values that were 0.05 or below ($p \leq 0.05$) were considered as implying the existence of a significant difference, while those above 0.05 ($p > 0.05$) were considered to imply no significant difference.

Weight affects the shape of a body, as extra fat tends to be deposited around the lower part of the torso, around the waistline or above the waistline, causing body shape variations and variations within the same body shapes. The body mass index (BMI), which gives an indication of the weight status, was therefore calculated using the weight mean and height mean for the Swazi women. The BMI was interpreted using the following BMI descriptors: Underweight: 18.5, Normal weight: 18.6 – 24.9, Overweight: 25 – 29.9, and Obese: 30 or higher. A summary of the data analysis procedures is shown in **Table 3.2**. The evaluation of the fit of the test garment was rated using a 1 – 9 fit evaluation scale, and interpreted with fit descriptors (see **Addendum G**).

3.8.3 Operationalisation

TABLE 3.2: OPERATIONALISATION IN TERMS OF OBJECTIVES, SUB-OBJECTIVES AND STATISTICAL METHODS

Objectives	Indicators	Statistical analysis
Primary objective 1: To identify and describe the most prevalent body shapes of young Swazi women through body dimensions.	Body dimensions (Anthropometry and Body shape standards)	Descriptive statistics: univariate analysis, the means and standard deviation were calculated for each variable. Drop values were calculated using M11 & M13, M16 & M13.
Primary objective 2: To identify and describe the body shapes of the currently used body forms through body dimensions.	Body dimensions (Anthropometry and Body proportion standards)	Descriptive statistics, univariate analysis, the means and the standard deviation were calculated for each variable.
Primary objective 3: To compare and describe the most prevalent body measurements and proportions of young Swazi women to those of currently used body forms.		
3.1 To analyse and compare the most prevalent body measurements and proportions of young Swazi women to those of currently used body forms (through measurements).	Body shapes (Body shape standards)	A Wilcoxon t-test was used to determine the level of significance at 5% level of significance
3.2 To investigate and determine whether there is a significant difference in body measurements and proportions of young Swazi women and currently used body forms.	Body shapes (Body shape standards)	
Primary objective 4: To test and evaluate the fit of the test garment which represents the size and most prevalent shape of the Swazi women, on the body forms.	Test garment and fit standards	No statistical analysis was done.

3.8.4 Explanation of statistical tests

3.8.4.1 Descriptive statistics

Descriptive statistics are also referred to as summary statistics as they are useful in summarising, organising and reducing large numbers of observations (McMillan & Schumacher, 2006:163). The nominal scale of measurement was relevant for this study as the labelling was done on mutually exclusive groups and was purely for differentiation purposes. The univariate analyses were done to summarise data on a single characteristic or variable, i.e. mean and frequency distribution. The numerical index that was used to indicate the average variability of the measurements from the mean was the standard deviation.

3.8.4.2 Wilcoxon t-test

The t-test is used to compare two means, i.e. it gives one mean difference. When the p value is equal to or below the scientifically established threshold of ($p \leq 0.05$), the difference is said to be significant. As the mean difference increases, the p level decreases, thus making it significant. The t-test assumes that the sample was drawn randomly from a population that was normal, with equal variances. However, if the underlying parameter has been violated then non-parametric tests are used. Non-parametric tests are also appropriate when the scale of measurement is nominal or ordinal (Best & Kahn, 2006:268). One of the non-parametric tests used is the Wilcoxon matched pairs signed ranks. It was appropriately used for this study because the parametric assumptions appeared in doubt and the type of data was clearly not interval scaled.

3.9 QUALITY OF DATA

3.9.1 Introduction

The aim of ensuring validity and reliability basically is to demonstrate that the inquiry was conducted in such a manner that ensured that the participants were accurately identified and described, appropriate methods and statistical procedures were used and to ensure that the study truly investigated what it purports to, without error (De Vos, 2005:160, Fraenkel *et al,* 2006; Gay *et al,* 2006).

3.9.2 Validity

Content validity

To ensure the content validity of this study, that is the degree to which the instruments used measured the intended content area, all the key concepts in the conceptual framework were identified after a comprehensive review of the literature. This ensured that the sampled body dimensions were representative of the whole content area being studied. Content validity is determined by expert judgement, and jury opinion. The formulated data collection form and instruments were subjected to scientific scrutiny by experts in the field, i.e. the study supervisor and experts in the field of fashion and apparel (Dooley, 2001; De Vos, 2005:161; Gay *et al,* 2006).

Face validity

The face validity of the measuring instruments, i.e. the degree to which the instruments appear to measure what they claim to measure, was used as an initial screening procedure in the selection of measuring instruments. This process was undertaken after a thorough review of the literature to determine which measuring instruments have been successfully used before. Since face validity is not a psychometrically sound way of establishing validity, as it is based on face value, it was strengthened by content validity (Dooley, 2001; De Vos 2005:161; Gay *et al,* 2006).

Consequential validity

To ensure consequential validity, that is the extent to which a measuring instrument creates harmful effects for the participants, during pilot testing, the researcher observed to determine whether the measuring exercise and instruments had adverse consequences on the participants. Those that were observed (some participants preferred to have private changing rooms instead of undressing in front of the other participants), were addressed accordingly before the actual data collection. Ethical concerns to some extent also addressed consequential validity as a participant's name was not used but each participant was assigned a code, and the measuring process was done in a room that afforded the participants privacy (De Vos 2005:162; Gay *et al,* 2006; Dooley, 2001; Fraenkel *et al,* 2006).

Internal validity

To address internal validity, which refers to the degree to which the methods and procedures used to generate the results can be trusted or are credible, and moreover that the participants were adequately described and identified, the following factors were taken into consideration:

1. The researcher underwent training for data collection in anthropometry, specifically on how to accurately take body measurements and on how to identify and locate body landmarks.

2. The selected participants accurately fitted the described target population, i.e. young Swazi women. There was no bias selection of subjects such as choosing women with a typical African shape/bottom-heavy figure type. The researcher ensured that the measuring session was not too long, as taking body measurements needs a high level of precision and accuracy which could tire the participants and researcher/measurer, thus compromising accuracy (for instance, through bad posture and taking measurements once instead of three times to find a mean).

3. In consumer science research, it is impossible to have a tightly controlled environment and monitor all events as one would be dealing with people, not objects. The researcher tried to have very little time elapsing between the beginning and the end of the fieldwork to control drastic changes (Dooley, 2001; Baker, 1999).

4. The researcher standardised procedures so that the same observational instruments were used throughout the research. The change of instrumentation, such as a switch to more advanced accurate technology, would have introduced a potential threat to the internal validity.

3.9.3 Reliability

To ensure the reliability of the study and to reduce error, the following steps were taken:

1. Participants were given cover letters informing them of the purpose of the research; this was also explained in person by the researcher. A strong rapport was developed and maintained with the participants to enable them to feel at ease during the measuring session.

2. The participants were assured of anonymity and confidentiality in order to inspire confidence. This was done by using codes for each data collection form instead of the participants' names, and only the researcher and her assistant had access to the data.

3. For the anthropometrical techniques, the researcher/measurer underwent initial training on measurement techniques and body landmarking, and practised while being observed by the trainer, being corrected as was necessary.

4. A dry run for the body measurement procedures, with subjects who were not part of the sample, was carried out to determine competence in taking the measurements. After the evaluation of the dry run of the body measurement session, the progression and ease of the measuring exercise was refined as needed; also, general problems of a poor flow plan encountered, were resolved (Lohman *et al,* 1988).

5. The participants were requested to sign a consent form to ensure that all the participants that participated in the study did so willingly, as they gave their consent to participate in the study.

3.10 ETHICAL CONCERNS

The participants were given a thorough account of the nature of the study, the main objectives and the significance of the study. This ensured that the participants gave their informed consent to be part of the study. Moreover, it ensured that the participants were not coerced into taking part in the study and hence their privacy was not invaded in any way. Participants were given the leeway to withdraw from the study at any time they felt the need to do so.

3.10.1 Hygiene

During the measuring process, the participants wore a two-piece body suit which was supplied by the researcher. To ensure cleanliness in cognisance of the importance of hygiene, after each use, the body suit was laundered and packed before it was used by another participant.

3.10.2 Privacy

During the measuring sessions each participant was afforded privacy as the measuring was done in a quiet room with only the measurer and the research assistant, without any spectators.

3.10.3 Ensuring confidentiality of research data

To overcome this concern, once the data in the study had been collected, the researcher made sure that no one other than the research assistant had access to the data. Since the names of the participants in this study have no significance they were not reflected in any data collection forms. This was done by assigning a number (code) to each form to ensure that the information (data) furnished cannot be linked to a particular subject. Furthermore, the researcher assured all the participants that all the data collected from or about them will be held in confidence and cannot be traced back to them. Their names will never be used in any publication that describes the research.

CHAPTER 4
DATA ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the results, discussion and interpretation as per the primary objectives of this study. The aim of this study was to identify distinctive body shapes and proportions of Swazi women and compare them to those of commonly used body forms. Anthropometric techniques were therefore used to obtain the body dimensions since there are no body scanners in Swaziland. A total of twenty three (23) measurements were obtained from a hundred and one (101) women aged between 18 and 30 years.

4.2 DEMOGRAPHIC CHARACTERISTICS

The selected demographic characteristics are presented in terms of: size, age, region and weight. The distribution of the participants in the study within the different variables were summarised using frequencies and percentages.

TABLE 4.1: PERCENTAGE DISTRIBUTION OF PARTICIPANTS BY SIZE (n = 101)

Size	Frequency	Percentage
Size 32	51	50.5
Size 34	50	49.5
Total	**101**	**100**

4.2.1 Size

The findings on the distribution of respondents by size are shown in **Table 4.1**. They show that 50.5% were a size 32, while 49.5% were a size 34. Size was a criterion for inclusion into the study, hence the researcher intentionally screened and identified a relatively equal percentage of participants per size category. This was done to enable the researcher to make inference in respect of both sizes.

TABLE 4.2: PERCENTAGE DISTRIBUTION OF PARTICIPANTS BY REGION (n = 101)

Region	Frequency	Percentage
Hhohho	22	21.8
Lubumbo	10	9.9
Manzini	41	40.6
Shiselweni	28	27.7
Total	**101**	**100**

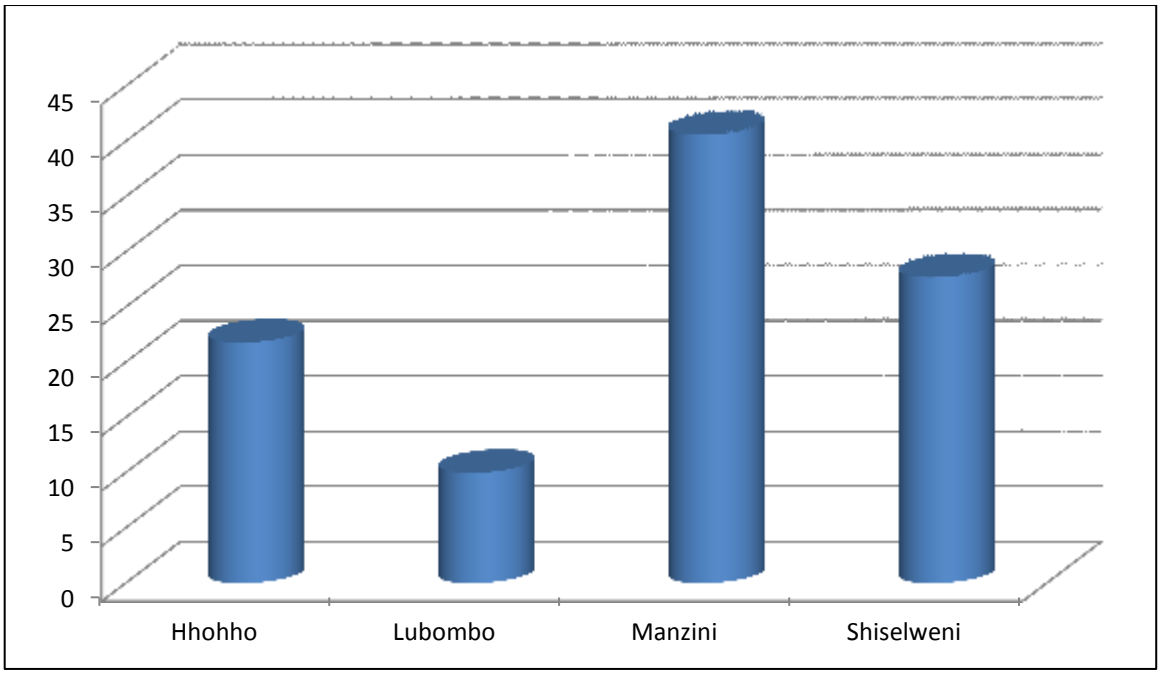


FIGURE 4.1: PERCENTAGE DISTRIBUTION OF PARTICIPANTS BY REGION

4.2.2 Region

The findings pertaining to the distribution of participants by region are shown in **Table 4.2** and **Figure 4.1.** They indicate that the majority (40.59%) of the participants were from the Manzini region, followed by the Shiselweni region and the Hhohho region accounting for 27.72% and 21.78% respectively. Only 9.9% were from the Lubombo region. This is to be expected due to population levels and the literacy rate per region in Swaziland. The Manzini region has the highest population (319530) and the Lubombo region has the lowest population (207731). Though the Hhohho region has a higher population (282734) compared to the Shiselweni region (208454), the literacy rate in the Shiselweni region is however higher (96.4%). This therefore explains the trend in the distribution of participants, i.e. the probability of more students coming from the Manzini region is higher because the Manzini region has more people and a high literacy rate (97.4%). A few participants came from the Lubombo region because it has a low population and the lowest literacy rate (94%), meaning only few people make it to the university.

TABLE 4.3: PERCENTAGE DISTRIBUTION OF PARTICIPANTS BY AGE (n = 101)

Age	Frequency Sizes 32 & 34	Percentage (%)
18	7	6.9
19	8	7.9
20	21	20.8
21	13	12.9
22	23	22.8
23	19	18.8
24	3	2.97
25	3	2.97
26	1	0.99
27	3	2.97
Total	**101**	**100**

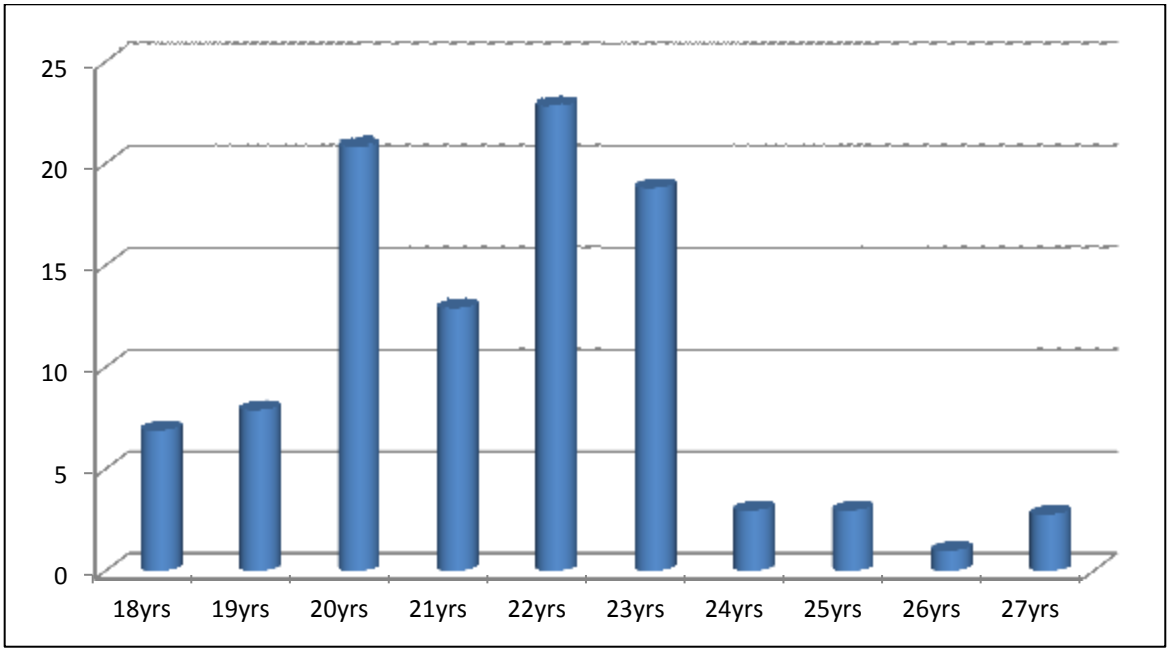


FIGURE 4.2: PERCENTAGE DISTRIBUTION OF PARTICIPANTS BY AGE

4.2.3 Age

The findings pertaining to the distribution of participants by age are presented in **Table 4.3** and **Figure 4.2**. There is an indication that the participants' ages range from 18 years to 30 years (as was intended). The bulk of the respondents are aged between 20 years and 23 years, with the majority (22.8%) aged 22 years. This is acceptable, as at this age range the young women are fully developed and have attained complete physical growth of full height, appropriate weight and an increase in size of all organs. If the participants were older than this age segment, they would have had figure variations correlated to their older age, e.g. increased weight and decreased height or an increase in girth measurements (i.e. in the bust, waist, abdomen and hips) due to fat deposits around these body areas.

TABLE 4.4: PERCENTAGE DISTRIBUTION OF PARTICIPANTS BY BMI AND WEIGHT (n = 101)

Percentage distribution of participants by BMI (n = 101)		
BMI Category	**Frequency**	**Percentage**
Normal	82	81.19
Overweight	15	14.85
Underweight	4	3.96
Total	**101**	**100**
Percentage distribution of participants by weight (n = 101)		
Weight (kg)	**Frequency**	**Percentage**
40-45	2	1.98
46–50	9	8.91
51-55	37	36.63
56-60	24	23.76
61-65	22	21.78
66-70	6	5.94
71-75	1	0.99
Total	**101**	**100**

BMI Descriptors: Underweight 18.5, Normal weight 18.6 – 24.9, Overweight 25 – 29.9

4.2.4 BMI and weight

The body mass index **(BMI)** was calculated for the participating Swazi women, as shown in **Table 4.4**. A majority (81.2%) of the Swazi women had a normal weight, while only 14.9% were overweight. This finding implies that weight would not have fit implications or have an effect on the body shape of Swazi women, as the Swazi women generally have a normal weight for their height.

Weight: The findings on the distribution of participants by weight are presented in **Table 4.4**. They reveal that the majority of the participants have a weight ranging between 51 kg and 60 kg, i.e. 51 – 55 kg (36.6%) and 56 – 60 kg (23.8%). Weight affects the shape of the body as extra fat tends to be deposited around the lower part of the torso or above the waistline, causing body shape variations and variations within body shapes. This will not be the case for the participating Swazi women as they have been found to have normal weight.

TABLE 4.5: PERCENTAGE DISTRIBUTION OF PARTICIPANTS BY HEIGHT CATEGORIES (n = 101)

Height				
Univariate analysis of height dimensions	**Mean**	**SD**	**Minimum**	**Maximum**
	159.2 cm	5.8 cm	144.0 cm	172.0 cm
Height categories	**Cut-off points**		**Count (%)**	
Short	Min to mean – SD 144 cm to 153.4 cm		19 (18.8%)	
Medium	Mean – SD to Mean + SD ≥ 153.4 cm to ≤ 165.0 cm		0 (69.3%)	
Tall	Mean + SD to max > 165.0 cm to 172.0 cm		12 (11.9%)	

**Min = Minimum range value; Max = Maximum range value*

4.2.5 Height

The findings on the distribution of the participants by height are presented in **Table 4.5**. Height is an important body dimension in the identification of body shapes and body proportions, as height would affect these. The sample was therefore first classified in terms of three height categories. The results show that a majority (69.3%) of the participants are of medium height, followed by the short height category (18.8%). Only 11.9% accounted for the tall height category. This finding implies that Swazi women are generally not tall and not too short, but are of medium height.

TABLE 4.6: PERCENTAGE DISTRIBUTION OF PARTICIPANTS BY HEIGHT PROPORTIONS (n = 101)

Height levels	Size	Short legs & long torso/low bust/waist/hip	Balanced/Ideal height proportion	Long legs & short torso/high bust/waist/hip
Bust	32	4 (7.8%)	1 (2%)	46 (90.2%)
	34	8 (16%)	0	42 (84%)
Waist	32	6 (11.8%)	0	45 (88.2%)
	34	2 (4%)	0	48 (96%)
Hip	32	0	0	51 (100%)
	34	0	0	50 (100%)

4.2.6 Height proportions

The findings on the distribution of the participants by height proportions are presented in **Table 4.6**. The comprehension of the effect of height proportions and body shapes on apparel fit is critical in the provision of better fitting apparel. With regard to size 32, the results show that a high percentage of the participants had a high bust level (90.2%), high waist (88.2%), and all had a high hip (100%). Very few of the participants had a low bust (7.8%)

and low waist (11.8%), while only (2%) appeared to have an ideal bust level. This trend was also evident in size 34, where a majority of the participants (84%) had a high bust level, 96% had a high waist, and all (100%) had a high hip. Only 16% accounted for a low bust and 4% for a low waist. These findings imply that Swazi women generally have higher height proportions compared to the ideal or balanced height proportions. In other words, most young Swazi women have a short torso and long legs compared to the upper body.

4.3 PRIMARY OBJECTIVE 1

To identify and describe the most prevalent body shapes of young Swazi women through body dimensions.

For purposes of this study, the relationships between the key body dimensions, i.e. bust, waist and hips, have been used as indicators of the different body shapes. Basically the relationship between the size (measurements) and shape of the body was used to interpret the actual resultant body shapes, guided by the established body shapes.

The identification of the body shapes was guided by the shape sorting steps and cut-off points used by Makhanya (2012), whereby the shape categories were not guided by the standards within the range values of the western body shapes. The decision not to use the western standards for body shape identification for the Swazi women was based on the understanding that there is variability within and between ethnic groups as well as variability across time (Connell *et al,* 2006). The recommended standards within the minimum and maximum range of drop values that have been used for this study are pertinent to the African body shapes, as the Swazi women are of course African.

Phase 1 was to identify the **inverted triangular** and the **triangular** body shape, using the hip minus bust drop value. The triangular body shape has a bust that is smaller than the hips, thus it has positive drop values, while the inverted triangular shape has a bust that is wider than the hips, thus has negative drop values (Rasband & Liechty, 2006:24; Lee *et al,* 2007). After identifying these two body shapes, they were removed from the data to allow the identification of the remaining body shapes that are not identified with this drop value. This ensured that no counter body shape identification was made.

Phase 2 was to identify the **hourglass, apple** and the **rectangular** body shapes, using the bust minus waist drop value. The rectangular, apple and hourglass body shapes have a bust

that is similar to the hips but a smaller waist, with an exception in the case of the apple shape, which has a wider waist. The hourglass has a higher drop value compared to the rectangular shape, while the apple is fuller around the waist compared to the bust. The apple shape was not found in the sample. The findings on the distribution of the participants by body shape are presented in **Table 4.7** and **Figure 4.3**.

TABLE 4.7: PERCENTAGE DISTRIBUTION OF SWAZI WOMEN BY BODY SHAPE (n = 101)

Body shape categories				
Phase 1				
Univariate analysis of drop values	**Mean**	**SD**	**Minimum**	**Maximum**
Hip minus bust	8.9 cm	5.2 cm	–2 cm	23 cm
Shape categories	**Cut-off points**		**Count (%)**	
Triangle	Mean to max 8.9 cm to 23 cm		55 (54.5%)	
Inverted triangle	Negative drop values		4 (4%)	
Phase 2				
Univariate analysis of drop values	**Mean**	**SD**	**Minimum**	**Maximum**
Bust minus waist	17.8 cm	3.8 cm	10 cm	28 cm
Shape categories	**Cut-off points**		**Count (%)**	
Hourglass	Mean to max 17.8 cm to 28 cm		35 (34.7%)	
Rectangle	< mean < 17.8 cm		7 (7%)	

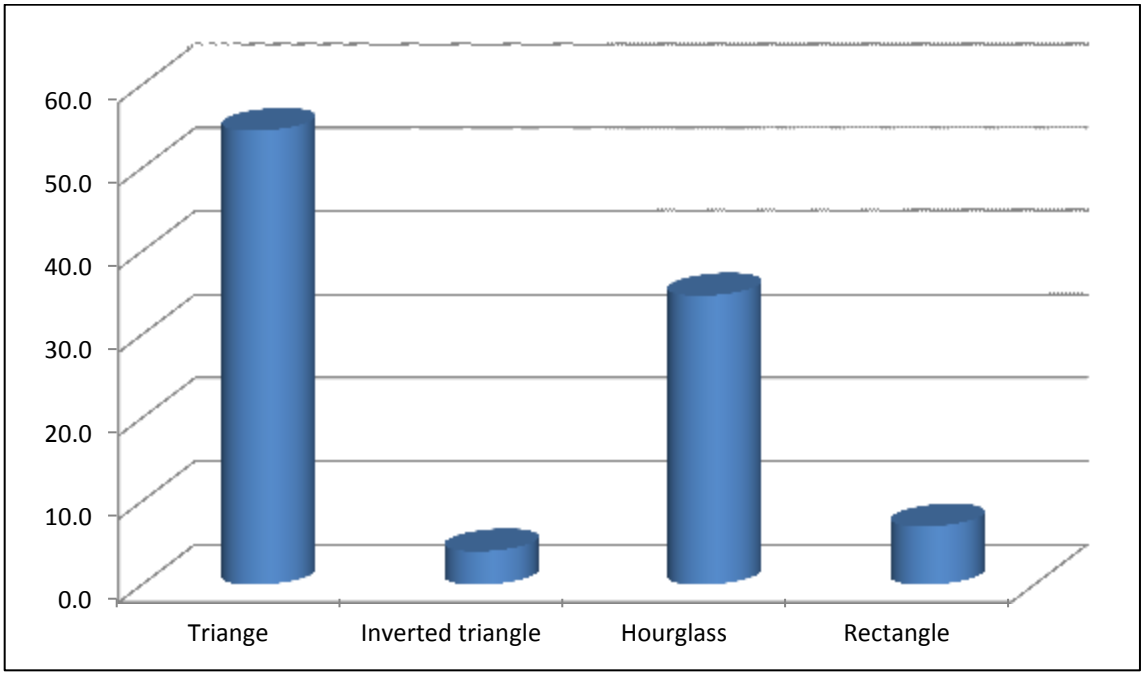


FIGURE 4.3: PERCENTAGE DISTRIBUTION OF SWAZI WOMEN BY BODY SHAPE

The findings on the distribution of the participants by body shape are presented in **Table 4.7** and **Figure 4.3**.

4.3.1 Emerging body shapes

It is evident from the findings that the most prevalent body shapes identified in the sample were the triangular body shape (54.5%), followed by the hourglass body shape (34.7%). The rectangular body shape and the inverted triangle were less prevalent, as the rectangular shape accounted for 7% whilst only 4% represented the inverted triangle body shape. These findings concur with the view that there is body type variation among and within ethnic groups, as shown by the fact that four different body shapes were identified within the sample of Swazi women. Furthermore, the findings underscore the notion that Swazi women are generally found to fall within four figure types, the most prevalent being the triangular/pear/bottom-heavy shape (Magagula & Zwane, 2006).

The ideal/hourglass body shape is used in pattern development and clothing design as a base body shape for ready-to-wear apparel by the clothing manufacturing industry (Connell *et al,* 2006). It is apparent from the above results that only 34.7% of the women in the sample fell within this body type, though all apparel is manufactured based on this body type. It is therefore highly probable that the Swazi women would experience fit problems with ready-to-wear clothing due to variations in figure types, as the Swazi women are predominantly triangular in shape.

TABLE 4.8: UNIVARIATE ANALYSIS OF THE TRIANGULAR BODY SHAPE FOR SWAZI WOMEN (n = 55)

Variable	Body proportion measurements	Size	Mean	SD	Minimum	Maximum
	Body proportions (cm)					
M6	Nape to natural waist (back)	32	35.63	1.77	32	39
		34	36.08	1.85	33	40
M7	Centre back waist (natural) to hip	32	18.67	1.42	16	22
		34	18.72	1.4	17	22
M8	Nape to bust point	32	31.93	1.93	28	36
		34	34.12	2.59	29	40
M9	Bust point to waist	32	13.57	1.92	8	17
		34	13.56	2.08	10	19
M18	Across back shoulders	32	37.13	2.06	33	42
		34	37.68	1.91	33	41
M19	Back width	32	30.73	1.51	28	34
		34	31.6	1.5	29	34
M20	Across chest (at the front)	32	28.53	1.22	26	31
		34	29.08	1.12	27	31
M21	Width of bust prominence	32	17.6	1.43	15	21
		34	17.88	2.03	14	23
WH16R	Waist to hip ratio	32	0.7	0.04	0.63	0.8
		34	0.71	0.03	0.67	0.78
WBR	Waist to bust ratio	32	0.8	0.04	0.74	0.88
		34	0.82	0.03	0.75	0.87
BH16R	Bust to hip ratio	32	0.87	0.03	0.78	0.91
		34	0.87	0.03	0.8	0.91
	Body circumferences (cm)					
M10	Neck base girth	32	37.67	1.54	35	41
		34	38.52	1.36	36	42
M11	Bust girth	32	81.97	2.53	78	87
		34	86.2	3.49	79	93
M12	Under-bust girth	32	69.73	1.39	68	72
		34	74.96	1.72	73	77
M13	Natural waist girth	32	65.93	3.15	60	74
		34	70.24	3.5	65	77
M14	Lower waist girth	32	72.7	3.74	66	79
		34	76.08	3.66	69	84
M15	Upper hip girth	32	82.9	5	71	93
		34	84.56	6.87	69	96
M16	Hip girth	32	94.6	3.55	90	105
		34	98.88	4.21	89	108
M17	Lower hip girth	32	101	3.52	94	109
		34	103.84	4.08	98	114
	Body extensions (cm)					
M22	Bust extension	32	13.2	1.16	11	15
		34	14.32	1.22	12	16
M23	Buttock extension	32	16.23	1.41	14	19
		34	17	0.96	15	19
	Height dimensions (cm)					
M1	Height	32	159.5	5.37	147	169
		34	160.12	6.12	148	172
M2	Nape to ground	32	137.3	5.03	128	147
		34	138.44	5.25	126	148
M3	Shoulder to ground	32	132.1	5.3	123	143
		34	132.88	5.7	122	144
M4	Natural waist to ground	32	103.97	5.24	92	114
		34	104.84	4.99	92	114
M5	Hip to ground	32	87.57	3.7	81	95
		34	88.68	4.73	82	98

4.3.2 Description of the identified prevalent triangular body shape

The univariate analysis for the triangular body shape identified within the sample of Swazi women is presented in **Table 4.8**. The most prevalent body shape identified within the sample was the triangular body shape. It was found to have the following traits: it appears to be wide below the waist in a constant progressive pattern to the lower hip dimension, which measures 35 cm and 34 cm more than the waist measurement for sizes 32 and size 34 respectively. The waist is much smaller in relation to the hips as shown by the low waist to hip ratio (0.7).

The shape has a heavy bottom, with the weight mainly concentrated in the rounded buttocks and wide rounded hips, as the lower hip is the widest girth. The hip bones (trochanterion) are well padded as shown in the difference of 6.4 cm and 5 cm for size 32 and size 34 respectively between the hip measurement and the lower hip measurement. The shape further indicated a dominant low hip curve and a high level of protrusion of the buttocks, i.e. 16.2 cm and 17 cm for size 32 and 34 respectively, as illustrated in **Figure 4.4**.

The body shape looks lopsided as it has a much smaller bust compared to the hip area, which measures 19 cm and 18 cm more than the bust girth for size 32 and size 34 respectively. The relatively low bust to hip ratio (0.87) also attests to the fact that the bust is smaller in relation to the hips. These traits that were found to constitute the identified triangular body shape are well aligned with the guiding principle that was employed to identify the body shape and concur with the description of the triangular body shape in the literature (Rasband & Liechty, 2006:24; Simmons *et al*., 2004a).

TABLE 4.9: UNIVARIATE ANALYSIS OF THE HOURGLASS BODY SHAPE FOR SWAZI WOMEN (n = 35)

Variable	Body proportions (cm)					
	Body proportion measurements	Size	Mean	SD	Minimum	Maximum
M6	Nape to natural waist (back)	32	35.44	1.75	32	39
		34	35.84	1.5	32	38
M7	Centre back waist (natural) to hip	32	18.31	1.7	16	23
		34	17.84	0.69	16	19
M8	Nape to bust point	32	32.25	1.44	30	35
		34	33.53	2.7	30	41
M9	Bust point to waist	32	13.75	2.02	10	17
		34	14	1.25	11	16
M18	Across back shoulders	32	38.19	1.36	34	43
		34	37.89	2.16	33	42
M19	Back width	32	31	1.06	29	35
		34	31.58	1.71	29	35
M20	Across chest (at the front)	32	28.75	0.83	27	30
		34	29.1	1.63	27	33
M21	Width of bust prominence	32	17.56	0.01	14	19
		34	17.89	1.45	15	20
WH16R	Waist to hip ratio	32	0.72	0.02	0.69	0.76
		34	0.72	0.03	0.66	0.78
WBR	Waist to bust ratio	32	0.76	0.02	0.71	0.79
		34	0.76	0.03	0.69	0.8
BH16R	Bust to hip ratio	32	0.94	0.02	0.91	0.99
		34	0.95	0.02	0.92	1
Body circumferences (cm)						
M10	Neck base girth	32	37.63	1.71	35	40
		34	38.16	1.42	35	40
M11	Bust girth	32	85.19	2.04	82	90
		34	88.95	2.32	85	94
M12	Under-bust girth	32	70.56	1.36	68	72
		34	75.21	1.32	73	78
M13	Natural waist girth	32	64.94	2.14	62	69
		34	67.47	2.99	63	74
M14	Lower waist girth	32	71.63	3.4	68	80
		34	74.42	4.35	68	85
M15	Upper hip girth	32	80.06	4.55	70	87
		34	83.37	3.98	77	91
M16	Hip girth	32	90.63	2.68	85	96
		34	93.42	3.15	89	101
M17	Lower hip girth	32	97.25	4.06	90	105
		34	99.68	4.06	93	108
Body extensions (cm)						
M22	Bust extension	32	13.75	1.06	12	16
		34	14.47	1.5	11	18
M23	Buttock extension	32	15.81	0.83	14	17
		34	15.84	1.54	13	19
Height dimensions (cm)						
M1	Height	32	159.06	6.82	145	169
		34	158.4	4.06	150	165
M2	Nape to ground	32	136.13	6.38	121	145
		34	135.68	3.97	128	142
M3	Shoulder to ground	32	131.13	6.8	115	141
		34	130.32	4.44	123	138
M4	Natural waist to ground	32	103.69	5.88	94	112
		34	104	3.73	97	111
M5	Hip to ground	32	87.75	6.14	80	102
		34	86.58	3.15	81	94

4.3.3 Description of the identified prevalent hourglass body shapes

The univariate analysis for the hourglass body shape identified within the sample of Swazi women is presented in **Table 4.9**. This shape was the second most prevalent body shape identified within the sample.

The hourglass body shape was found to have the following distinct features: it has a smaller waist in relation to the hips and bust. The hips measured 25.7 cm and 26 cm more than the waist for size 32 and size 34 respectively, while the bust measured 20.3 cm and 21.5 cm more than the waist for size 32 and size 34 respectively. This is affirmed by the low waist to hip ratio and waist to bust ratio, i.e. 0.72 and 0.76 respectively in both sizes.

The difference between the hip and the bust measurement was very minimal, i.e. 5.4 cm and 4.5 cm for size 32 and size 34 respectively. This notion was affirmed by the high bust to hip ratio of 0.95, with a maximum of 1, implying that the difference between the bust and hip was minimal to none. There is a constant progression from a smaller natural waist girth measurement to a wider well-padded lower hip, which measured 6.6 cm and 6.3 cm more than the hip measurement for size 32 and size 34 respectively. It is notable that this was a common trait for the identified triangular shape and the hourglass shape. The progressive pattern from a small waist to a wide bust was also evident with regard to the waist and bust relationship.

An hourglass shape is said to be proportionate as it is said to have a relatively similar bust and hip measurement, with a small waistline. These findings are therefore well aligned with this guiding principle that was used to identify the shape, as the bust and hip circumferences were relatively equal, with a smaller waist.

Of interest to note is the fact that, though the guiding principles in defining body shapes are fundamental, the descriptive parameters within the minimum and maximum range values for the participating Swazi women and the western body shapes were not identical. This underscores the importance of considering the shape sorting cut-off point to employ in view of the ethnicity of the population under study.

4.3.4 Body shape silhouettes of the prevalent body shapes among the Swazi women

To aid understanding of the shape of the Swazi women further, a visual frontal perspective and a side view of the Swazi women were generated. A selection of girth and linear measurements relevant to pattern development aided in the generation of a two-dimensional

view. A central plumb line or balance line was used to divide the front view of the body from the pit of the neck to the ground for the frontal perspective, and from the earlobe to the ground for the side view.

The illustration aided in depicting the outline of the actual geometric shapes of the two body shapes that were shown to be the most prevalent in the sample of Swazi women. The girth measurements for each of the prevalent body shapes for these Swazi women were used to generate the actual two-dimensional torso for each body shape, i.e. the triangular and hourglass shapes. Only the girth measurements necessary for the generation of the front view of the shape were used, i.e. bust, under-bust, natural waist, lower waist, upper hip, hip and lower hip.

The bust and buttock extensions were used to depict the side view of the body shapes, to show the extent of the protrusion. The axis or balance line was vertically aligned at the centre of the body, while for the side view it was aligned with the position of the ear. The body measurements were reduced to a smaller scale, hence all the measurements that were used to generate the diagram were divided by a common figure. The other body dimensions save the ones mentioned above are therefore not representative of the Swazi body shapes, but acted as a frame to show the relationship of the dimensions that were used for this exercise. One should note however that due to the limitations of the method that was used to generate the illustration, the angles of the body shapes were not captured.

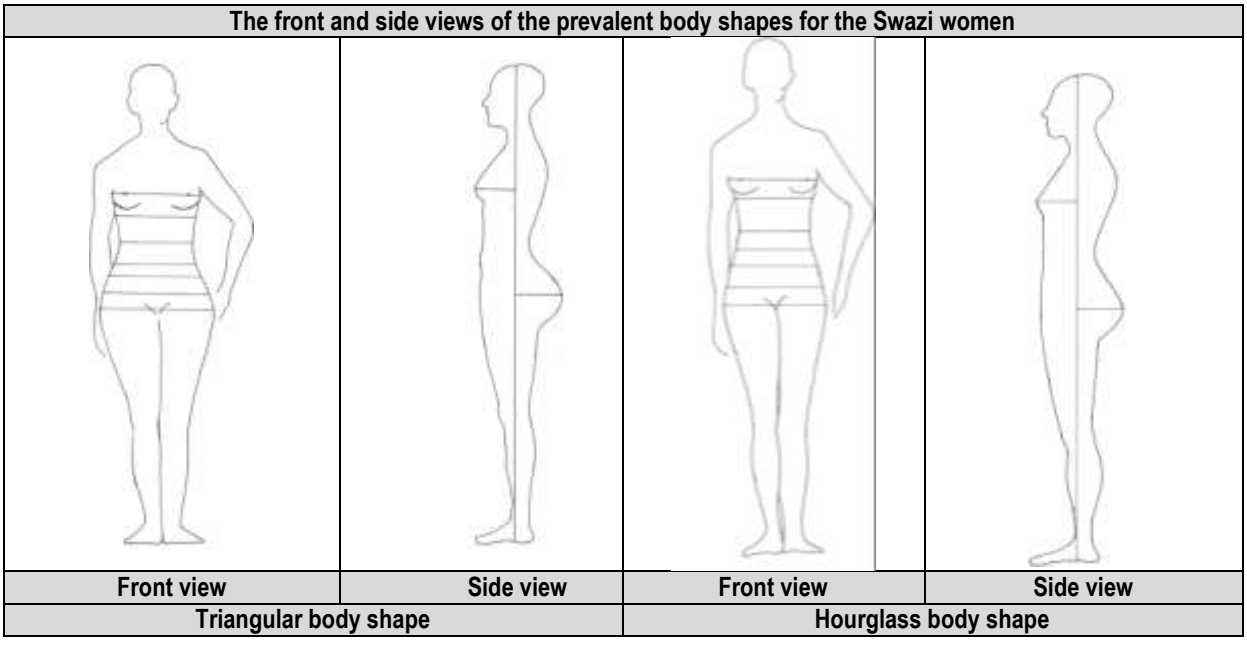


FIGURE 4.4: DIAGRAMMATIC DEPICTION OF THE PREVALENT BODY SHAPES FOR THE SWAZI WOMEN

Figure 4.4 shows a diagrammatic presentation of the actual two-dimensional torso for the triangular and hourglass body shapes of the young Swazi women. It is visually evident from the side view diagram for the triangular shape that the extent of protrusion for the buttocks is higher than that of the bust. This finding is supported by the difference between the bust extension and buttock extension measurements, i.e. 3 cm and 2.7 cm for size 32 and size 34 respectively. This is in agreement with Rasband & Liechty (2006), namely that the triangular shape has a heavy bottom and smaller bust area.

The geometric triangular shape after which the triangle body shape is called, is clearly portrayed in the front view of the body shape. The front view also shows that the shape appears to be disproportionate as the hip area is conspicuously much bigger than the bust and shoulder area, with a very small waistline. The front view of the hourglass, on the other hand, appears to be proportionate at the hip and bust areas, while it also has a small waistline. Though this shape appears to be proportionate as the hip and bust appear similar from the front view, the side view tells a different story: the degree of protrusion for the buttock is also higher than that of the bust.

4.4 PRIMARY OBJECTIVE 2

To identify and describe the body shapes of the currently used body forms through body dimensions.

Body forms represent the common standards used to test the fit of clothing, therefore are milled using the average size and shape of target markets (Yu, 2004a: 36). The conventional body forms based on western standards are currently used by Swazi small-scale apparel manufacturers. To identify the shapes of the body forms therefore, the recommended western standards within the minimum and maximum range values were employed. The relationship between the key dimensions or inflection points of the body are major indicators used to identify and interpret body shapes. The three key dimensions, i.e. hips, waist and bust, where the body contours change in movement aided in interpreting the shape differences.

TABLE 4.10: BODY MEASUREMENTS FOR THE BUST, WAIST AND HIPS OF THE BODY FORMS

Inflection points	Size	Body form (B1)	Body form (B2)
Bust	32	81	84
	34	95	89
Waist	32	60	64
	34	72	69
Hip	32	88	86
	34	100	92

The measurements for the key body dimensions for size 32 and size 34 of the body forms are presented in **Table 4.10**. A constant linear increment pattern is recognised from one size to the next, i.e. from size 32 to size 34 in all three measurements for both body form brands. In other words, the body forms increase from one size to the next at a uniform pace for all three measurements, e.g. the increment factor from the waist to the bust is 12 cm and from the waist to the hip it is 28 cm in brand 1, while from the waist to the bust it is 5 cm for brand 2. According to Gupta and Gangadhar (2004), Shin and Istook (2007) and Apeagyei (2010), a key dimension is generally distributed evenly across the system in an attempt to cover the broadest range of measurements, e.g. the waist measurements for sizes 2-10 are 2.5 cm apart, for sizes 12-16 they are 3.8 cm apart, and for size 18 and above, they are 5 cm apart. The findings are however contrary to this view as the measurements from size 32 to 34 at the waist were 12 cm apart for brand 1 and 5 cm apart for brand 2, instead of 2.5 cm apart as suggested.

The issue of vanity sizing is also seen to be at play regarding the two body form brands, as the measurements for size 32 in the brand 1 body form are different from those in the brand 2 body form in the same size. Glaring shape features of the body forms are that the brand 1 body forms are smaller at the bust and waist and slightly wider at the hip area, in comparison to the brand 2 body forms. As mentioned above, the identification of the shapes of the body forms was guided by the standards within the range values of the western body shapes. Drop values were used to classify the body shapes of the currently used body forms using descriptive parameters to classify western body shapes as they are based on western anthropometric data. Two different brands of body forms were measured for this study and the body shape of each was identified.

Mossiman (1988) concluded that body shape is not dependent on size. He alluded to the fact that persons who wear a specific size category cannot all be assumed to be the same body shape. The understanding of Mossiman's (1988) conclusion underlay the manner in which the shapes of the body forms were identified, i.e. in order for the body form to be identified as

shaped in a particular body shape, both sizes studied had to satisfy the recommended standards within the minimum and maximum range of drop values.

4.4.1 The criterion used to identify the shapes of the body forms

Phase 1: The first step was to identify the triangular body shape and the inverted triangular body shape using the hip minus bust drop value. The triangular body shape appeared to be unbalanced as it had a narrow bust that was smaller than the hips, thus had positive drop values, while the inverted triangular body shape had a bust that was wider than the hips, thus had negative drop values.

Phase 2: The second step was to identify the hourglass/ideal, apple and the rectangular body shapes using the bust minus waist drop value. The rectangular, apple and hourglass body shapes had a bust that was aligned to the hips but a smaller waist, with an exception to the apple shape which has a wider waist. The hourglass had a higher drop value compared to the rectangular shape, while the apple was fuller around the waist compared to the bust.

TABLE 4.11: DISTRIBUTION OF BODY FORMS BY BODY SHAPE

Body shape categories *(Phase 1)*				
Body form brands	**Taile B1**		**Sierra B2**	
Size	**32**	**34**	**32**	**34**
Hip minus bust	7	5	2	3
Shape categories	**Recommended standards within the minimum and maximum range of drop values**		**Count**	
			Taile B1	**Sierra B2**
Triangle	≥ 5 cm to maximum *i.e. if the hip is 5 cm or more wider than the bust then the shape is a triangle*		2 *(Size 32 & 34)*	0
Inverted triangle	≥ 2.5 cm to maximum *i.e. if the bust is 2.5 cm or more larger than the hip, then the shape is an inverted triangle.*			0
Body form brands	**Taille B1**		**Sierra B2**	
Size	**32**	**34**	**32**	**34**
Bust minus waist	21 cm	23 cm	20 cm	20 cm
Shape categories	**Recommended standards within the minimum and maximum range of drop values**		**Count**	
			Taile B1	**Sierra B2**
Ideal	> 17.5 cm to ≤ 25 cm i.e. *if bust = hip and the waist is 25 cm smaller, then the shape is ideal*			2 *(Size 32 & 34)*
Hourglass	> 25 cm to maximum *i.e. if bust = hip and the waist is 27.5 cm smaller, then the shape is hourglass*			
Rectangle	Minimum to ≤ 17.5 cm *i.e. if bust = hip and the waist is 17.5 cm or less than the bust and hip, then the shape is rectangular*			

The findings on the identification of the shapes of the body forms are presented in **Table 4.11**. It is evident from the findings that the identified shape of the currently used body forms was the **triangular** body shape for the brand 1 body forms, and an **ideal/hourglass body shape** for the brand 2 body forms. One can therefore conclude that the body forms are shaped differently from each other.

The brand 1 body forms were found to conform to the western standards of a triangular body shape, while the Swazi women were also found to be triangular shaped as per the African standards. Though both shapes were found to be triangular, the standards within the minimum and maximum range of drop values were however different. There was a glaring disparity between the range from minimum to maximum for the body forms and that of the Swazi women. The range from minimum to maximum for the body forms was 5 cm to 7 cm, while the range from mean to maximum for the Swazi women was 8.9 cm to 23 cm. This observation implies that, although both shapes were found to be triangular, there are notable differences with regard to the degree of the body contours, i.e. the Swazi women are conspicuously heavier and more rounded at the hip area (as the measurement differences

that are evident from the findings show). The expectation that this body form would offer a better fit for Swazi women as they have similar body shapes, may in principle not be realised due to the vast differences in the drop values.

The ideal body shape is often also referred to as the hourglass body shape, while in actual fact they are slightly different though they both have a hip that is relatively equal to the bust, i.e. the hips and the shoulders are aligned. The slight difference however is that the hourglass shape is said to be disproportionate as it has a very small waist, i.e. 27.5 cm smaller in proportion to the hips and the bust measurements, while the ideal body shape on the other hand has a proportionate waist, i.e. 25 cm smaller in relation to the hip and the bust dimensions, hence it is said to be proportionate. In order to afford coherence with the literature, the ideal shape will be referred to as hourglass. The ideal/hourglass body shape is used in pattern and clothing design as a base body shape for ready-to-wear apparel by the clothing manufacturing industry, which probably explains why the brand 2 body form is ideal/hourglass shaped.

It is therefore highly probable that the Swazi women will experience fit problems with ready-to-wear clothing due to variations in figure types, as the Swazi women are predominantly triangular in shape.

4.5 PRIMARY OBJECTIVE 3

To describe and compare the most prevalent body measurements and proportions of young Swazi women to those of currently used body forms.

4.5.1 Sub-objective 3.1

To analyse and compare the most prevalent body measurements and proportions of young Swazi women to those of currently used body forms (through measurements).

4.5.2 Sub-objective 3.2

To investigate and determine whether there is a significant difference in body measurements and proportions of young Swazi women and currently used body forms.

Studies often put emphasis on statistically significant differences, yet these differences may be very small hence of little importance, implying that no concrete fit implications can be drawn from them. For purposes of this study, significant differences were regarded in view of the practical measurement differences and their fit implications in pattern design. The findings on the comparisons of the body proportions for the hourglass body shape for Swazi women and the body proportions for the two brands of body forms for sizes 32 and 34, and the determination whether the differences are significant or not, are presented in **Table 4.12**.

TABLE 4.12: A COMPARISON OF THE SWAZI WOMEN HOURGLASS BODY SHAPE TO THE TWO BODY FORM BRANDS FOR SIZES 32 & 34

#	Body dimensions	Size	Brand 1 (Body form)			Brand 2 (Body form)		
			Mean	SD	*P*	Mean	SD	*P*
1	Nape to natural waist (back)	32	-3.56	1.75	0.0001	-2.56	1.75	0.0002
		34	0.84	1.5	0.0235	-2.16	1.5	0.0000
2	Natural centre back waist to hip	32	-1.69	1.7	0.0076	0.31	7.70	0.5974
		34	-1.16	0.69	0.0000	-0.16	0.69	0.5312
3	Nape to bust point	32	-1.75	1.44	0.0013	-0.75	1.44	0.0532
		34	-1.47	2.7	0.0224	-1.47	2.7	0.0224
4	Bust point to waist	32	-5.25	2.02	0.0000	-3.25	2.02	0.0001
		34	-3	1.25	0.0000	-4.0	1.25	0.0000
5	Neck base girth	32	-1.38	1.71	0.0089	-3.38	1.71	0.0000
		34	-1.84	1.42	0.0000	-3.84	1.42	0.0000
6	Bust girth	32	4.19	2.04	0.0000	1.19	2.04	0.0356
		34	-6.05	2.32	0.0000	-0.05	2.32	0.7987
7	Under-bust girth	32	-0.44	1.36	0.2488	-2.44	1.36	0.0000
		34	-3.79	1.32	0.0000	-2.78	1.32	0.0000
8	Natural waist girth	32	4.94	2.14	0.0000	0.94	2.14	0.1499
		34	-4.53	2.99	0.0003	-1.53	2.99	0.0304
9	Lower waist girth	32	-4.38	3.40	0.0014	4.63	3.40	0.0000
		34	-7.58	4.35	0.0000	2.42	4.35	0.0475
10	Upper hip girth	32	-7.94	4.55	0.0000	0.06	4.55	0.7755
		34	-9.63	3.98	0.0000	7.37	3.98	0.0000
11	Hip girth	32	2.63	2.68	0.0041	4.63	2.68	0.0001
		34	-6.58	3.15	0.0000	1.42	3.15	0.0718
12	Lower hip girth	32	9.25	4.06	0.0000	11.25	4.06	0.0000
		34	-0.32	4.06	0.7764	7.68	4.06	0.0000
13	Across back shoulders	32	3.19	2.29	0.0002	-0.81	2.29	0.1428
		34	-3.12	2.16	0.0000	-1.11	2.16	0.0401
14	Back width	32	-1.0	1.55	0.0529	2	1.54	0.0001
		34	-4.42	1.71	0.0000	0.58	1.71	0.1862
15	Across chest	32	-2.25	0.86	0.0000	0.75	0.86	0.0080
		34	-4.89	1.63	0.0000	-0.89	1.63	0.0328
16	Width of bust prominence	32	-0.44	1.36	0.2232	-0.44	1.36	0.2232
		34	-4.12	1.45	0.0000	-1.11	1.45	0.0050
17	Bust extension	32	1.75	1.06	0.0001	-1.25	1.06	0.0020
		34	0.47	1.50	0.1435	-0.53	1.50	0.1618
18	Buttock extension	32	2.81	0.83	0.0000	2.81	0.83	0.0000
		34	0.84	1.54	0.0355	1.84	1.54	0.0002

Significant at $p \leq 0.05$. The mean values in the table show the mean measurement differences between the measurements of the Swazi women and those of the body forms.
Negative (-)values = Swazi measurements are smaller.
Positive (+)values = Swazi measurements are greater.

Nape to natural waist (back): It is evident from the findings that there was a significant difference ($p \leq 0.05$) in the nape to natural waist length of the Swazi women hourglass shape and that of the two brands of body forms in both sizes. The measurement for Swazi women was generally shorter by a maximum of 3.56 cm compared to the body forms, except when compared to brand I size 34 where it was bigger by 0.84 cm. There will be fit implications for Swazi women using patterns made from both body forms, except when using the size 34 brand 1 body form where the difference was minimal, i.e. less than 1 cm. These would include excess fabric length from the nape to the natural waist, causing the garment waistline to be lowered at the back waist instead of fitting at the waistline.

Natural back waist to hip: According to the findings, there was a significant difference ($p \leq 0.05$) in the natural back waist to hip length of the Swazi women and that of the brand 1 body forms in both sizes. The measurement for Swazi women was shorter by a maximum of 1.69 cm compared to the brand 1 body forms. This implies that patterns made from the brand 1 body forms will have slightly excess fabric length from the waist back to the hipline to fit attractively on Swazi women. There was however no significant difference between the Swazi women and brand 2 body forms for both sizes, thus no fit implications are expected as the difference is quite minimal, i.e. 0.31 cm and 0.16 cm for sizes 32 and 34 respectively.

Nape to bust point: It is evident from the findings that there was a significant difference in both sizes ($p \leq 0.05$) for the nape to bust point length of the Swazi women and that of the brand 1 body form in both sizes and of the size 34 brand 2 body form. There was however no significant difference between the Swazi women and the size 32 brand 2 body forms, hence no fit implications are expected as the measurement difference (0.75 cm) was too small to have any implications. The findings show that the measurement for Swazi women was shorter by a maximum of 1.75 cm compared to the brand 1 body form. Patterns made from a size 32 or 34 of the brand 1 body form or a size 34 of the brand 2 body form would have fit implications for Swazi women. The fabric length from the shoulder seam to the bust point would be slightly longer, thus slightly dropping the bust-line and consequently the bust point of the garment to below the bust level, thus lowering the bust darts from their position.

Bust point to waist: It is evident from the findings that there was a significant difference ($p \leq 0.05$) in the bust point to waist length of the Swazi women and that of the two brands of body forms for both sizes. The findings show that the distance between the bust point and the waist for the Swazi women is shorter by a maximum of 5.25 cm compared to the brand 1 body forms, and by 4 cm compared to the brand 2 body forms. This implies that patterns made from both the body forms will have fit implications such as excess fabric length forming

folds between the bust and the waist. Consequently, the garment waistline may be lowered below the body waistline level.

Neck base girth: The findings show that there was a significant difference ($p \leq 0.05$) in the neck base girth of the Swazi women and that of the two brands of body forms in both sizes. Swazi women were generally found to have a smaller neck base girth by a maximum of 1.84 cm compared to the brand 1 body forms and by 3.84 cm compared to the brand 2 body forms. This finding denotes that the neckline for a pattern made from both the body form brands would be loose fitting and gape unattractively, standing away from the neck of Swazi women as they have a small neck base in comparison to the body forms.

Bust girth: The findings show that there was a significant difference ($p \leq 0.05$) in the bust girth of the Swazi women and that of the two brands of body forms, except for the size 34 brand 2 body forms. It is apparent from the findings that both the body forms have a smaller bust girth for size 32 compared to the Swazi women. The Swazi women have a bigger bust girth by 4.19 cm compared to the brand 1 body forms, and 1.19 cm compared to brand 2 body forms. The following fit problems pertinent to a bigger bust will be experienced by Swazi women when using patterns made from both body forms. There will be very little fabric width across the bust area resulting in tightness that would lead to the formation of horizontal strain lines over the bust area. Swazi women were however found to have a much smaller bust girth in size 34 compared to the brand 1 body forms by 6.05 cm, thus will have excess fabric width causing looseness across the bust area and the formation of vertical hang lines over the bust area.

Under-bust girth: The findings show that there was no significant difference in the under-bust girth of the Swazi women and that of the size 32 brand 1 body forms, as the measurement for Swazi women was shorter by only 0.44 cm which is negligible as it would have no fit implications. There was however a significant difference between the measurement of Swazi women and that of the brand 2 body forms for both sizes and for size 34 brand 1 body forms. The under-bust girth for the body forms is wider than that of the Swazi women, as the measurements for Swazi women were smaller by a maximum of 3.79 cm. This implies that when Swazi women use these brands of body forms for pattern-making, there would be excess fabric width around the under-bust girth area, causing poor style shaping or design definition from the bust to the under-bust girth, e.g. for empire style dresses.

Natural waist girth: It is apparent from the findings that there was a significant difference ($p \leq 0.05$) in the natural waist girth of the Swazi women and that of the body form brands,

except for the size 32 brand 1 body forms, as the measurement difference was only 0.94 cm. Though the analysis reflects that the difference has no significance, it is however very close to 1 cm, hence bordering on practical significance as 1 cm would make a difference on fit at the waistline for close-fitting styles. The Swazi women may therefore experience very slight tightness around this area. Both body form brands in size 32 had a smaller girth measurement in comparison to the Swazi women as the Swazi women were bigger by a maximum of 4.94 cm. This is a wide disparity between the two and it would have fit implications. The following fit problems inherent to a wide waistline will be experienced by Swazi women when using patterns made from especially size 32 brand 1 body forms. The fabric width will not be enough to fit comfortably around the waistline area and fastening a garment will not be easy as the edges of a garment opening will not meet comfortably. For size 34 in both body form brands the Swazi women were found to have a smaller girth measurement by up to 4.53 cm, thus they will experience the following fit problems inherent to a small waistline. There would be excess fabric width to fit comfortably around the waistline area, resulting in poor waistline definition for example in dresses, and very loose, gaping waistbands that drop to the lower waist level for example in pants and skirts.

Lower waist girth: It is evident from the findings that there was a significant difference ($p \leq 0.05$) in the lower waist girth of the Swazi women and that of the two brands of body forms in both sizes. The findings show that the Swazi women had a smaller measurement compared to brand 1 body forms by a maximum of 7.58 cm. This finding implies that the brand 1 body forms have a big abdomen, hence Swazi women using these body forms for pattern-making would have excess fabric around the abdomen area which would make the garment fit loosely and hang unattractively. The Swazi women on the other hand were found to be wider compared to the brand 2 body forms by a maximum of 4.63 cm. This would lead to the brand 2 body form patterns being too tight, thus forming horizontal strain lines or riding up to the waist and shortening the garment on Swazi women. The garment may also cup under the abdomen instead of hanging attractively from the waistline.

Upper hip girth: It is apparent from the findings that there was a significant difference ($p \leq 0.05$) in the upper hip girth of the Swazi women and that of the body forms, except for the size 32 brand 2 body form. The measurement for Swazi women was generally smaller compared to the brand 1 body forms, i.e. by a maximum of 9.63 cm, implying that the Swazi women have a narrower upper hip girth compared to the brand 1 body form. When Swazi women use the brand 1 body form for pattern-making, the garment will have a very loose fit and will form undefined horizontal folds as there would be excess fabric around the upper hip curve. With regard to the brand 2 body form there was no significant difference between the Swazi women and the body forms for size 32, as the difference between the measurements

was a mere 0.1 cm – thus of no practical value. There was however a significant difference between the Swazi women and the size 34 brand 2 body forms. The Swazi women were found to be 7.37 cm wider, thus patterns made from these body forms would yield garments that have a very tight fit, or the garment would not fit at all at the upper hip level. Horizontal strain folds would be created causing the garment to ride up to the natural waistline level, thus affecting the length of the clothing item.

Hip girth: The findings indicate that there was a significant difference ($p \leq 0.05$) in the hip girth of the Swazi women and that of the two brands of body forms, except for the size 34 brand 2 body forms as the measurement difference was minimal and would not have fit implications. The findings show that the Swazi women were wider by a maximum of 4.63 cm for size 32, compared to both body forms. The fit implications for Swazi women are that there would be insufficient fabric width in clothes to fit around the hips. This would result in the formation of horizontal ripples or folds around the hip area that ride up to around the waistline. On the other hand, Swazi women were found to be much narrower, i.e. by 6.58 cm, in comparison to the size 34 body forms. This difference was quite wide and will invariably have fit implications at the hip area. Due to the fact that the patterns from these body forms would be bigger at the hip area, the garments would be too loose and would hang over this area, causing poor hip definition for the styles except in loose-fitting styles.

Lower hip girth: The findings show that there was a significant difference ($p \leq 0.05$) in the lower hip girth of the Swazi women and that of the two brands of body forms, except for the size 34 brand 1 body form as the measurement difference was only 0.32 cm, which is very small and should not have any fit implications. The Swazi women had a much wider, lower hip girth by a maximum of 11.25 cm, compared to the body forms. This finding implies that the hip bones of the young Swazi women are well-padded as reflected in the measurement difference between the hip measurement and the lower hip measurement. The body forms on the other hand have no padding, as the hips measures exactly the same as the lower hip measurement. The fit implications for Swazi women in clothes that are draped on either of the body form brands are that the fabric width would not be enough to fit around the hips. If the garment is forced at all over the hip area it would result in the formation of very tight horizontal ripples or folds around the hip area that ride up to around the waistline.

Across back shoulders: The findings show that there was a significant difference ($p \leq 0.05$) with regard to the across back shoulder length for the Swazi women and that of the body forms, except for the size 32 brand 1 body form as the measurement difference was 0.81 cm. Though this amount appears to be negligible, it is however critical at this body dimension as a slight difference here would impact on fit. The Swazi women are slightly broader compared

to the size 32 brand 1 body forms by 3.19 cm. Swazi women may experience the following fit problems associated with broad shoulders: there will be slight tightness at the shoulders that would inhibit free movement of the arms, thus exerting strain on the armhole seam. On the other hand, Swazi women were found to have narrower shoulders by up to 3.12 cm in size 34 for both body form brands. They will therefore experience the following fit problems, i.e. the garment will be loose across the shoulders, causing loose vertical ripples to form on the sleeve cap and drooping sleeves that fall off the sleeve cap due to the long shoulder seams.

Back width: It is evident from the findings that there was no significant difference in the back width length of the Swazi women and that of size 32 brand 1 body forms and size 34 brand 2 body forms, as the mean difference was minimal, i.e. -1 cm and 0.58 cm respectively. Though the difference between the Swazi women and the size 32 brand 1 body forms was found to be insignificant, i.e. the Swazi women were narrower by 1 cm, it would however have a slight effect of looseness, especially at the armhole seam. There was a significant difference ($p \leq 0.05$) in the measurements for the Swazi women and those for size 34 brand 1 and size 32 brand 2 body forms. The Swazi women were found to have a wider back width length by 2 cm, compared to the brand 2 body forms. This would exert a slight amount of strain on the armhole seam for close-fitting styles. On the other hand, Swazi women were found to have a narrower back width by 4.42 cm, compared to size 32 brand 1 body forms. Thus garments made from these body forms will have slightly more fabric width than necessary across the upper back, causing slight looseness as it would not fit snugly and the armhole seams would be slightly offset from their position.

Across chest at the front: It is apparent from the findings that there was a significant difference ($p \leq 0.05$) across the chest at front length of the Swazi women and that of the two brands of body forms in both sizes. The measurement for Swazi women was noticeably shorter by up to 4.89 cm than that of the brand 1 body forms. This difference cannot be absorbed during the pattern-making process, hence would have fit implications that include excess fabric width across the chest, resulting in the formation of vertical ripples at the sides of the chest near the armhole seam-line and the armhole seam will be offset from its position. Though there was also a significant difference between the Swazi women and the brand 2 body form, the difference was too small (0.75 cm and 0.89 cm for sizes 32 and 34 respectively) to have any fit implications.

Width of bust prominence: There was no significant difference in this measurement for Swazi women and that of both body form brands in size 32. The measurement for Swazi women was shorter by only 0.44 cm compared to both body forms, which difference is too small to have any fit implications for the Swazi women. There was however a significant

difference in the measurement for Swazi women and that of the body forms in size 34. The Swazi women were found to have a shorter width by up to 4.12 cm in comparison to the body forms. This difference is quite wide and would thus have fit implications, which will be more pronounced when using the brand 1 body forms. The tip of bust darts and bust point on Swazi women will be shifted away to the sides from the apex resulting in a very loose fit around the front bust area.

Bust extension: There was a significant difference in this measurement for Swazi women and that of both body form brands in size 32. The bust for Swazi women was extended by 1.75 cm compared to the brand 1 body forms, and it was less extended (by 1.25 cm) compared to the brand 2 body forms. This finding implies that there would be too much strain on the bust area for Swazi women using patterns made from the brand 1 body forms, while the garments may be slightly loose around the bust area when using brand 2 body forms. These differences would especially have fit implications in bras. There was however no significant difference in the bust extension length for the Swazi women and that of the two brands of body forms in size 34. There is therefore no disparity between the bust extension dimensions for the Swazi women and those of the body form brands. This implies that no fit problems will be experienced by Swazi women when using patterns made from the body form brands in size 34 with regard to the bust extension dimensions. The difference for both body forms compared to the Swazi women is about 0.5 cm, which measurement is too small to have any fit implications.

Buttock extension: The findings show that there was a significant difference ($p \leq 0.05$) in the buttock extension for the Swazi women and that of the two brands of body forms in both sizes. The Swazi women were found to have a more pronounced buttock extension length (by 2.81 cm) compared to the body form brands. This finding implies that the buttock extension for the Swazi women is more extended outward compared to those of both the body forms. This means that Swazi women would have fit problems with clothes that are draped on both the body forms. The clothes would not have enough width as the garment will be pulled tight across the buttock area. The side seams will not align well with the Swazi body as it will bow backward at the low hip level. The skirt hemline will be pulled up at the back causing the hemline to poke out at the centre. Strained fabric cups under the buttocks and tight diagonal ripples can form pointing towards the buttock curve. The waistband may be slightly pulled down in pants and skirts.

In summary, it is evident from the findings that the hourglass-shaped young Swazi women are significantly different from the brand 1 body forms in terms of measurements and proportions. The major critical differences that will have an impact on fit in the length

dimensions were noted in the nape to waist in size 32 and bust point to waist in both sizes, whereby the Swazi women were found to be much shorter. With regard to the girth dimensions, the Swazi women appear to be smaller in all the girth dimensions in size 34, especially from the bust girth up to the hip girth, with a difference margin ranging from 4 cm to 9.63 cm at the upper hip girth, thus a noticeably loose fit will pose a problem to young Swazi women. Pertaining to size 32 girth dimensions, a different trend emerged compared to size 34. Young Swazi women appeared much bigger specifically at the bust, waist and lower hip girths, with a difference margin range of 4.19 cm to 9.25 cm. This is an alarming difference that will undoubtedly translate to tightness around these areas. Except for the across the back shoulder measurement, there were tolerable measurement differences in the size 32 width dimensions. However, in size 34, the young Swazi women had smaller/narrower width dimensions, implying that a predictable problem of looseness will be experienced at these dimensions as a slight difference in width dimensions is critical. The well-extended buttocks in combination with much wider lower hips in size 32 will pose major fit problems in terms of tightness for young Swazi women.

With regard to the hourglass-shaped young Swazi women and the brand 2 body form, young Swazi women generally had shorter length dimensions – more so at the bust point to waist measurement, thus waist dart will pass over the bust points. With regard to the girth dimensions, the young Swazi women were very wide at the upper hip and lower hip girths. The measurement differences were cause for concern as they ranged from 7.37 cm to 11.25 cm, thus tightness shown by riding up wrinkles is inevitable around the hip area.

TABLE 4.13: A COMPARISON OF THE SWAZI WOMEN TRIANGULAR BODY SHAPE TO THE TWO BODY FORM BRANDS FOR SIZES 32 & 34

#	Body dimensions	Size	Brand 1 (Body form)			Brand 2 (Body form)		
			Mean	SD	*P*	Mean	SD	*P*
1	Nape to natural waist (back)	32	-3.37	1.77	0.0000	-2.37	1.77	0.0000
		34	1.08	1.85	0.0101	-1.92	1.85	0.0003
2	Natural centre back waist to hip	32	-1.33	1.42	0.0002	0.67	1.42	0.0133
		34	-0.28	1.4	0.2986	0.72	1.4	0.0174
3	Nape to bust point	32	-2.07	1.93	0.0000	-1.07	1.93	0.0066
		34	-0.88	2.59	0.0690	-0.88	2.59	0.0696
4	Bust point to waist	32	-5.43	1.92	0.0000	-3.43	1.92	0.0000
		34	-3.44	2.08	0.0000	-4.44	2.08	0.0000
5	Neck base girth	32	-1.33	1.54	0.0003	-.3.33	1.54	0.0000
		34	-1.48	1.36	0.0002	-3.48	1.36	0.0000
6	Bust girth	32	0.97	2.53	0.0584	-2.03	2.53	0.0006
		34	-8.8	3.49	0.0000	-2.8	3.49	0.0012
7	Under-bust girth	32	-1.27	1.39	0.0002	-3.27	1.39	0.0000
		34	-4.04	1.72	0.0000	-3.04	1.72	0.0000
8	Natural waist girth	32	5.93	3.15	0.0000	1.93	3.15	0.0030
		34	-1.76	3.5	0.0274	1.24	3.5	0.1461
9	Lower waist girth	32	-3.3	3.74	0.0002	5.7	3.74	0.0000
		34	-5.92	3.66	0.0000	4.08	3.66	0.0001
10	Upper hip girth	32	-5.1	4.95	0.0000	2.9	4.95	0.0032
		34	-8.44	6.87	0.0001	8.56	6.87	0.0001
11	Hip girth	32	6.63	3.55	0.0000	8.63	3.55	0.0000
		34	-1.12	4.21	0.1992	6.88	4.21	0.0000
12	Lower hip girth	32	13	3.52	0.0000	15.0	3.52	0.0000
		34	3.84	4.08	0.0002	11.84	4.08	0.0000
13	Across back shoulders	32	2.13	2.06	0.0001	-1.87	2.06	0.0002
		34	-3.32	1.91	0.0000	-1.32	1.91	0.0032
14	Back width	32	-1.27	1.51	0.0004	1.73	1.51	0.0000
		34	-4.4	1.5	0.0000	0.6	1.5	0.0777
15	Across chest	32	-2.47	1.22	0.0000	0.53	1.22	0.0250
		34	-4.92	1.12	0.0000	-0.92	1.12	0.0012
16	Width of bust prominence	32	-0.4	1.43	0.1169	-0.4	1.43	0.1169
		34	-4.12	2.03	0.0000	-1.12	2.03	0.0098
17	Bust extension	32	1.2	1.16	0.0001	-1.8	1.16	0.0000
		34	0.32	1.22	0.1953	-0.68	1.22	0.0120
18	Buttock extension	32	3.23	1.41	0.0000	3.23	1.41	0.0000
		34	2	0.96	0.0000	3	0.96	0.0000

Significant at p ≤ 0.05. The mean values in the table show the mean measurement differences between the measurements of the Swazi women and those of the body forms.
Negative (-)values = Swazi measurements are smaller.
Positive (+)values = Swazi measurements are greater.

Findings on the comparison of the body proportions for the triangular body shape for Swazi women and the body proportions for the two brands of body forms commonly used for size 32 are presented in **Table 4.13**.

Nape to natural waist (back): The findings show that there was a significant difference (p ≤ 0.05) in the nape to natural waist length of the Swazi women and that of the two brands of body forms in both sizes. The measurement for Swazi women was 3.37 cm shorter compared to the size 32 brand 1 body form and the brand 2 body form in both sizes, thus

there would be excess fabric length from the nape to the natural waist, causing a fold to form and pile at the back waist. The garment waistline may also be lowered at the back waist instead of fitting at the waistline, thus affecting the positioning of the hipline at the hip level. The Swazi women were however found to be 1.08 cm longer compared to the size 34 brand 1 body forms. This difference is minimal, but since it is a linear measurement it is critical.

Natural back waist to hip: It is evident from the findings that there was a significant difference ($p \leq 0.05$) in the natural back waist to hip length of the Swazi women and that of both the body form brands, except for the size 34 brand 1 body form where the measurement difference was a mere 0.28 cm. The measurement for Swazi women was shorter by up to 1.33 cm compared to the brand 1 body form, and longer by up to 0.72 cm compared to the size 34 brand 2 body form. The use of the brand 1 body forms would produce patterns with a longer measurement at the natural back waist to hip measurement, which would result in the ill-positioning of the hipline level as it would be lowered, or the formation of excess fabric folds between the waistline and the hipline levels. The measurement difference between the Swazi women and the brand 2 body forms is minimal but would affect fit by slightly shifting the positioning of the hipline up since it is a linear measurement.

Nape to bust point: The findings indicate that there was a significant difference ($p \leq 0.05$) in the nape to bust point length of the Swazi women and that of both the body form brands in size 32. The measurement for Swazi women was shorter by up to 2.07 cm compared to the brand 1 body forms, and by 1.07 cm compared to the brand 2 body forms, hence patterns made from either of the body form brands would have fit implications for Swazi women. The measurement difference implies that there would be excess fabric length, thus slightly dropping the bust-line of the garment to below the bust level. This would lower the bust points from their position or cause the neckline to shift away slightly from the shoulder and neckline point, thus affecting the positioning of the armhole seam. There was however no significant difference between the measurements for Swazi women and the body forms in size 34. The measurement difference was -0.88 cm, implying that the Swazi women were shorter in comparison. Though the difference is said to be insignificant, it would still have a slight impact on fit at the positioning of the bust point.

Bust point to waist: The findings show that there was a significant difference ($p \leq 0.05$) in the bust point to waist length of the Swazi women and that of the two brands of body forms. The distance between the bust point and the waist for the Swazi women was shorter by up to 5.43 cm compared to the brand 1 body forms, and by up to 4.44 cm compared to the brand 2 body forms. This implies that patterns made from both the body forms will have fit

implications as there will be excess fabric length forming folds between the bust and the waist, but concentrated at the waistline.

Neck base girth: The findings show that there was a significant difference ($p \leq 0.05$) in the neck base girth of the Swazi women and that of the two brands of body forms. Swazi women were found to have a smaller neck base girth by a maximum of 1.48 cm compared to the brand 1 body forms, and by up to 3.48 cm compared to brand 2 body forms. This finding denotes that the neckline for a pattern made from either of the body form brands will be loose-fitting and will gape unattractively standing away from the neck of Swazi women, as they have a small neck base in comparison to the body forms.

Bust girth: The findings indicate that there was no significant difference ($p \leq 0.05$) in the bust girth of the Swazi women and that of the brand 1 body forms size 32. The Swazi women had a slightly wider bust girth by 0.97 cm, compared to the brand 1 body form. The measurement difference is however too small to pose any fit problems. However, there was a significant difference between the Swazi women and the size 34 brand 1 body forms, as the Swazi women were 8.8 cm smaller compared to the body forms, and 2.8 cm smaller than the brand 2 body forms. This is a wide disparity and as a consequence, Swazi women may experience the following fit problems pertinent to a small bust girth. There will be excess fabric width across the bust area, causing the formation of vertical folds and an over-garment look over the bust area. These fit problems will be pronounced with the use of the size 34 brand 1 body forms.

Under-bust girth: The findings show that there was a significant difference in the under-bust girth of the Swazi women and that of both body form brands. The measurement for Swazi women was smaller by up to 4.04 cm compared to the brand 1 body forms, and by 3.27 cm compared to the brand 2 body forms. As a result of this difference, when Swazi women use the body form brands for pattern-making there would be excess fabric width around the under-bust girth area, causing looseness and poor design definition at the under-bust girth. This would be pronounced with the brand 2 body forms in both sizes and size 34 brand 1 body forms.

Natural waist girth: There was a significant difference ($p \leq 0.05$) in the natural waist girth of Swazi women and that of both the body form brands, except for the size 34 brand 2 body form, where the Swazi women were found to be 1.24 cm wider compared to the body forms. Though the difference was found to be insignificant, it will result in a very slight tightness in close-fitting styles. The measurement for the Swazi women was more by 5.93 cm compared to that of the size 32 brand 1 body forms, and by 1.93 cm compared to that of the size 32

brand 2 body forms. The following fit problems inherent to a wide waistline will be experienced by Swazi women when using patterns made from these body forms, especially brand 1: there will be insufficient fabric width to fit comfortably around the waistline area, resulting in tightness at the waistline. Strain will be exerted to the fastener as the edges may not meet or it may be fastened with difficulty. However, with regard to size 34 brand 1 body form, the Swazi women were found to be smaller by 1.76 cm at this dimension, which will result in very slight looseness in close-fitting styles.

Lower waist girth: It is clear from the findings that there was a significant difference ($p \leq 0.05$) in the lower waist girth measurement of the Swazi women and that of the body form brands. The Swazi women were smaller by 3.3 cm and 5.92 cm, compared to the brand 1 body forms for size 32 and 34 respectively. This implies that there will be excess fabric width around this dimension that will hang clumsily over the abdomen when using the brand 1 body forms. With regard to the brand 2 body forms, the Swazi women were found to be wider by 5.7 cm and 4.08 cm for size 32 and 34 respectively, which was quite a wide margin. Swazi women will therefore experience tightness around the lower waist girth and the garment may cup the abdomen, giving the style design a distorted look.

Upper hip girth: There was a significant difference ($p \leq 0.05$) in the upper hip girth of the Swazi women and that of both the body form brands. The measurement for Swazi women was smaller when compared to that of the brand 1 body forms, namely by 5.1 cm and 8.44 cm for sizes 32 and 34 respectively. When Swazi women use the brand 1 body form for pattern-making, the garment will have a very loose fit, forming undefined horizontal folds that may rest at the lower hip area if it fits well, as there would be excess fabric around the upper hip curve. This fit problem will be pronounced when using size 34. On the other hand, Swazi women were found to be wider at this dimension when compared to brand 2 body forms, by 2.9 cm and 8.56 cm for sizes 32 and 34 respectively. Thus Swazi women are bound to experience fit problems when using this body form for pattern development, i.e. the garment will be strained and will form horizontal strain folds around this area. The fit problems will be more pronounced when using size 34.

Hip girth: It is apparent from the findings that there was a significant difference ($p \leq 0.05$) in the hip girth of the Swazi women and that of both body form brands. The measurement for the Swazi women was wider by 6.63 cm compared to the brand 1 body forms, and by 8.63 cm compared to the brand 2 body forms. These differences are quite significant and will invariably have fit implications for Swazi women at the hip area. There will be insufficient fabric width, thus the garment cannot be pulled over the hip area. However if the wearer manages to pull the garment over the hip area, there will be extreme strain exerted on the

side seams. The garment may form horizontal strain lines that will ride up to the upper hip or waist area, thus distorting the style appearance.

Lower hip girth: The findings show that there was no significant difference in the lower hip girth of the Swazi women and that of the brand 1 body forms. The measurement for Swazi women was much wider (by 13 cm) compared to the brand 1 body forms, and by 15 cm compared to the brand 2 body forms. These are significantly wide gaps which will have adverse effects to fit for Swazi women. The fabric width will be inadequate to fit around the lower hip area. Hence it would not be possible to pull the garment over this area or fasten it as the edges for the fastener would not come together. If the garment is forced at all over the hip area it would result in the formation of extremely tight horizontal ripples or folds around the lower hip area, exerting a lot of strain on the side seams and causing the garment to ride up to the upper hip girth or to around the waistline. The garment will also cup the buttocks unattractively.

Across back shoulders: There was a significant difference ($p \leq 0.05$) across the back shoulder length for the Swazi women and that of both the body form brands. It is evident from the findings that the measurement for Swazi women is generally smaller compared to that of the body forms, except for size 32 in brand 1, where the measurement for the Swazi women was found to be 2.13 cm wider. This difference will cause slight tightness in the garments across the shoulders. On the other hand, Swazi women were found to be up to 3.32 cm narrower compared to the body forms. Thus patterns made from the size 34 brand 1 body forms and the brand 2 body forms would yield garments that would be slightly too loose across the shoulders. This fit problem will be more pronounced with the use of the size 34 brand 1 body form.

Back width: The findings indicate that there was a significant difference in the back width length of the Swazi women and that of the brand 1 body forms. Swazi women were found to be smaller by 1.27 cm and 4.4 cm for size 32 and size 34 respectively. This will have fit implications as there will be excess fabric width across the upper back, hence the garment will be slightly loose and the armhole seam will be slightly offset from it is expected position. When compared to the brand 2 body forms, the measurement for the Swazi women was wider by 1.73 cm in size 32, implying that the garment would be tight exerting strain on the armhole seams. There was however no significant difference between the Swazi women and the size 34 brand 2 body forms as the measurement difference was a mere 0.6 cm, which was too small to pose any fit problems.

Across chest at the front: There was a significant difference ($p \leq 0.05$) across the chest at front length of the Swazi women and that of the two brands of body forms. The measurement for Swazi women was 2.47 cm and 4.92 cm shorter for size 32 and size 34 respectively compared to that of the brand 1 body forms, which difference is wide enough to have fit implications during the pattern-making process. There will be excess fabric width across the chest, resulting in the formation of a slight vertical ripple at the sides of the chest near the armhole seam, or the armhole seam will be offset from its position. These fit problems will be more conspicuous when using the size 34 brand 1 body forms. Though there was also a significant difference between the Swazi women and the brand 2 body form, the differences were too small, i.e. 0.53 cm and 0.97 cm for size 32 and 34 respectively. Very little to no fit implications are therefore expected for the Swazi women in relation to this body dimension with the use of the brand 2 body forms.

Width of bust prominence: The findings show that there was no significant difference in the measurements for Swazi women and that of both body form brands in size 32, as the measurement difference for both body form brands was merely 0.4 cm. This difference is too small and would thus have no fit implications. On the other hand, the findings show that there was a significant difference in the measurement for Swazi women and that of both body form brands in size 34. The measurement for the Swazi women was narrower by 4.12 cm compared to the brand 1 body forms, and by 1.12 cm compared to the brand 2 body forms. The Swazi women will therefore experience the following fit problems: there will be excess fabric, causing the bust points not to align with the apex. A horizontal soft bowed fold from apex to apex will be evident when using the brand 1 body forms, as this problem will be worse with the brand 1 body forms.

Bust extension: It is evident from the findings that there was a significant difference in the bust extension length for the Swazi women and that of the two brands of body forms in size 32, and in size 34 of the brand 2 body forms. The measurement for Swazi women was 1.2 cm more than that of the brand 1 body forms and 1.8 cm less than that of the brand 2 body forms in size 32. These measurement differences are bound to have fit implications. With regard to the brand 1 body forms, Swazi women will experience a very slight tightness which may only affect ease. With regard to the brand 2 body forms, Swazi women will experience a slight looseness around the bust prominence area. There was very little difference between the measurements for Swazi women and the body forms in size 34, thus no fit problems are expected.

Buttock extension: The findings show that there was a significant difference ($p \leq 0.05$) in the buttock extension for the Swazi women and that of the two brands of body forms. The

Swazi women were found to have a more pronounced buttock extension length compared to both body form brands. The buttock extension for the Swazi women was extended by a maximum of 3.23 cm compared to both body form brands. This finding means that Swazi women will have fit problems with clothes that are draped on both the body forms. There would be insufficient fabric width, hence the clothes will be slightly pulled tight across the buttock area and perhaps cup the buttocks.

In summary, there were glaring measurement differences that will have a practical influence on fit, between the triangular shaped young Swazi women and brand 1 body forms. With regard to the length dimensions, young Swazi women were much shorter at the bust point to waist measurement. This observation also held true for the hourglass-shaped women, implying that Swazi women are generally short at this dimension. Young Swazi women were much smaller at the bust girth, under-bust girth, lower waist girth and especially at the upper hip girth in size 34, and will thus experience looseness at these measurements. There was much cause for concern at the vast measurement differences at the hip and lower hip girth in combination with well-extended buttocks in size 32, where the young Swazi women were much wider by up to 13 cm at the lower hip girth. This implies that Swazi women will experience tightness around these areas.

With regard to the young Swazi women and the brand 2 body forms, the bust to waist dimension, as also noted with the hourglass-shaped Swazi women, was much shorter for Swazi women. This will affect the placement of the waistline and the front waist darts. The Swazi women appeared to be much wider by comparison at the girth dimensions, specifically at the lower waist, upper hip (34), hip and lower hip girths. It is therefore predictable that Swazi women will experience severe tightness around these areas.

One notes with interest that there is no clear relationship between size 32 and size 34 in terms of the measurements for young Swazi women compared to those of the body forms. A tendency for instance of wideness below the waistline that may emerge in size 32 for Swazi women compared to a particular body form brand, may not necessarily emerge in size 34 – instead an opposite tendency may emerge. This observation is incongruent with the assumption that human beings increase at a uniform rate in length, width and height.

4.6 PRIMARY OBJECTIVE 4

To test and evaluate the fit of the test garment which represents the most prevalent body shape of the Swazi women on the body forms.

The search for a perfect fit in clothing culminates in a fit session, be it at the manufacturing level or retail level. Manufacturers strive to ensure that garments fit the wearer comfortably and allow ease of movement, therefore establishing the relationship between body size and shape is vital in the provision of fitting apparel. There are notable differences in body size and shape that relate to among other things ethnicity (Apeagyei, 2010). There is a need therefore to evaluate the fit of the test garment made by using measurements for the most prevalent body shape within the Swazi women on the body forms to determine the efficiency (with regard to Swazi women) of the body forms in pattern development.

TABLE 4.14: FIT EVALUATION SCORES FOR THE TEST GARMENT ON THE TWO BODY FORM BRANDS FOR SIZES 32 & 34

#	Body measurements	Evaluation scores			
		Brand 1 (size 32)	Brand 1 (size 34)	Brand 2 (size 32)	Brand 2 (size 34)
1	Nape to natural waist	8	7	8	8
2	Natural centre back waist to hip	9	9	9	9
3	Nape to bust point	5	7	7	7
4	Bust point to waist	9	8	9	8
5	Bust girth	6	9	9	9
6	Natural waist girth	3	9	8	9
7	Lower hip girth	1	3	2	2
8	Across back shoulders	7	9	8	8
9	Back width	7	9	8	9
10	Across chest	7	7	5	6
11	Width of bust prominence	5	8	5	7
12	Bust extension	6	6	8	8
13	Buttock extension	1	3	1	2

Fit evaluation scale:

1 = Too long / loose *2 = Long / loose* *3 = Slightly long/loose* *4 = Satisfactory fit* ***5 = perfect***
6 = Satisfactory fit *7 = Slightly short/tight* *8 = Tight/short* *9 = Too short/tight*

The evaluation scores for the fit test are presented in **Table 4.14**. The fit evaluation scale below the table was used to rate the fit of the test garments on the body forms.

4.6.1 The fit of the test garment on Brand 1 size 32 body forms

The test garment was hort at the nape to natural waist, natural centre back waist to hip, and bust point to waist, and slightly tight across the chest, at the back width and across the back

shoulder. The opposite was found to be true for the buttock extension and lower hip girth, as the test garment was found to be too loose while it was slightly loose at the natural waist girth. There was a satisfactory fit at the bust extension and bust girth and a perfect fit was only at the nape to bust point and width of bust prominence dimensions (**Figure 4.5**).

Visual presentation of fit for brand 1 (size 32)		
		
B 1 (32) Front view	B 1 (32) Side view	B 1 (32) Back view

FIGURE 4.5: VISUAL PRESENTATION OF FIT FOR BRAND 1 (SIZE 32)

4.6.2 The fit of the test garment on Brand 1 size 34 body forms: The test garment was too short at the natural centre back waist to hip and short at the bust point to waist dimensions, while it was slightly short at the nape to natural waist and nape to bust point. It was found to be very tight at the bust girth and back width and tight at the natural waist girth, across the back shoulders and at the width of bust prominence, while it was slightly tight across the chest. The tightness at the bust, under-bust and waist girths resulted in the wide gaping of the test garment that is evident at the back due to the fact that the edges of the opening could not meet (see **Figure 4.6**). There was a satisfactory fit at the bust extension and a slightly loose fit at the buttock extension and the lower hip girth (**Figure 4.6**).

Visual presentation of fit for brand 1 (size 34)		
		
B 1 (34) Front view	B 1 (34) Side view	B 1 (34) Back view

FIGURE 4.6: VISUAL PRESENTATION OF FIT FOR BRAND 1 (SIZE 34)

4.6.3 The fit of the test garment on Brand 2 size 32 body forms

The fit at the bust girth, natural waist girth, across the back shoulders, back width and at the bust extension was tight. This resulted in the difficulty of the back opening edges to meet at the centre back as shown by the gaping at the back, and short at the nape to natural waist, natural centre back waist to hip, and bust point to waist dimensions, while it was slightly short at the nape to bust point dimension. The test garment was found to be loose at the lower hip girth and the buttock extension dimensions. There was a perfect fit across the chest and the width of bust prominence (**Figure 4.7**).

Visual presentation of fit for brand 2 (size 32)		
		
B 2 (32) Front view	B 2 (32) Side view	B 2 (32) Back view

FIGURE 4.7: VISUAL PRESENTATION OF FIT FOR BRAND 2 (SIZE 32)

4.6.4 The fit of the test garment on Brand 2 size 34 body forms

The fit was satisfactory across the chest, while it was tight at the back width and across the shoulder dimensions. The bust girth, natural waist girth, and bust extension also exhibited tightness, while the width of bust prominence was slightly tight. The test garment was found to be slightly short at the nape to bust point and short at the nape to natural waist, bust point to waist and natural centre back waist to hip dimensions. The test garment was found to be loose only at the lower hip girth and buttock extension dimensions (**Figure 4.8**).

Visual presentation of fit for brand 2 (size 34)		
		
B 2 (34) Front view	B 2 (34) Side view	B 2 (34) Back view

FIGURE 4.8: VISUAL PRESENTATION OF FIT FOR BRAND 2 (SIZE 34)

4.7 A COMPARISON OF THE FIT TEST RESULTS TO THE T-TEST RESULTS

The means of all the measured dimensions of the young Swazi women were compared to those of each of the body form brands in objective 3. A t-test was employed to determine whether there were significant differences and further showed the mean differences. The levels of significance in conjunction with the mean differences were then used to predict pertinent fit problems. The fit of the test garment constructed using the measurements of the most prevalent body shape of young Swazi women, was evaluated on each of the body form brands and the resultant levels of fit were observed, as discussed above. It is of the essence therefore, to examine whether the fit problems predicted or assumed by the t-test are consistent with the observations made during the evaluation and assessment of the fit test. The discussion was focused on the results of the triangular shape only, as the test garment was constructed using the measurements of the most prevalent (triangular) shape of young Swazi women.

TABLE 4.15: COMPARISON OF THE FIT TEST TO THE T-TEST FOR THE BRAND 1 BODY FORM SIZE 32

#	Body dimensions	Fit test		T-test	
		B1 (32)		Triangular body shape & B1 (32)	
		Evaluation scores	Interpretation	Mean difference	*(p)*
1	Nape to natural waist	8	Short	-3.37	0.0000
2	Natural centre back waist to hip	9	Too short	-1.33	0.0002
3	Nape to bust point	5	Perfect fit	-2.07	0.0000
4	Bust point to waist	9	Too short	-5.43	0.0000
5	Bust girth	6	Satisfactory fit	0.97	0.0584
6	Natural waist girth	3	Slightly loose	5.93	0.0000
7	Lower hip girth	1	Too loose	13	0.0000
8	Across back shoulders	7	Slightly tight	2.13	0.0001
9	Back width	7	Slightly tight	-1.27	0.0004
10	Across chest	7	Slightly tight	-2.47	0.0000
11	Width of bust prominence	5	Perfect fit	-0.4	0.1169
12	Bust extension	6	Satisfactory fit	1.2	0.0001
13	Buttock extension	1	Too loose	3.23	0.0000

Fit evaluation scale:

1 = Too long / loose *2 = Long / loose* *3 = Slightly long/loose* *4 = Satisfactory fit* ***5 = perfect***
6 = Satisfactory fit *7 = Slightly short/tight* *8 = Tight/short* *9 = Too short/tight*

Significant at $p \leq 0.05$.
The mean difference values show the differences between the measurements of the Swazi women and those of the body forms. Negative (-) values = Swazi measurements are smaller, and positive (+) values = Swazi measurements are greater.

4.7.1 A comparison between the fit test and the t-test for the size 32 brand 1 body form

Triangular body shape:

The comparison between the fit test and the t-test for the size 32 brand 1 body form is presented in Table 4.15.The t-test indicated a significant difference with a negative mean difference for the **nape to natural waist, natural centre back waist to hip** and **the bust point to waist**, implying that the Swazi women were short at these dimensions. The fit test on the other hand found these lengths to be short to too short. The t-test and the fit test are therefore in agreement as the test garment was expected to be short at these areas due to the fact that Swazi women were found to be shorter, and indeed that was the case.

With regard to the **bust girth**, the t-test found no significant differences between the measurements for the Swazi women and the body forms, as the measurement difference was only 0.97 cm. Though the Swazi women were slightly bigger at this dimension, the fit test indicated a satisfactory fit with a score of 6 at this dimension, as the measurement difference did not impact on the fit of the test garment, thus the t-test and the fit test are in agreement.

The t-test indicated significant differences at the **natural waist girth, lower hip girth** and **buttock extension** with positive mean difference values, which implies that the Swazi women were bigger at these body dimensions, while the fit test found these dimensions to have a loose fit. The two tests are therefore in agreement as the significant differences impacted on the fit of the test garment, resulting in looseness, as the Swazi women were shown to be bigger than the body forms at these body dimensions.

For the **back width** and **across chest** measurements the test garment was found to have a slightly tight fit, while the t-test indicated significant differences with negative mean differences, thus implying that the Swazi women were smaller at these dimensions. The t-test and the fit test were therefore in agreement, as the significant difference between the measurements for the Swazi women and those of the body forms had an impact on the fit of the test garment.

With regard to the **width of bust prominence** the t-test found an insignificant difference between the measurements of the Swazi women and those of the body forms with a mean difference value of 0.4 cm, while the test garment was found to have a perfect fit on the body form. This was expected as the measurements for the Swazi women and the forms were relatively equal as the difference was too small to have an impact on fit at this body dimension.

The t-test indicated a significant difference between the measurements for the Swazi women and the body forms with regard to the **bust extension** dimension. The mean difference was 1.2 cm, implying that the Swazi women were slightly bigger. Though the Swazi women were shown to be slightly bigger at this dimension, the fit test indicated a satisfactory fit with a score of 6 at this dimension as the measurement difference was not much, thus did not impact on the fit of the test garment, therefore the t-test and the fit test are in agreement.

There was a discrepancy between the findings of the t-test and the fit test with regard to the **nape to bust point** and **across back shoulders** body measurements. The t-test indicated that there was a significant difference for the nape to bust point measurement which had a mean difference of -2.07 cm, meaning that the Swazi women were shorter at this dimension, but the fit test found the test garment to have a perfect fit at this dimension. There was also a significant difference for the across back shoulder measurement with a mean difference of 2.13 cm, meaning that the Swazi women are broader at this dimension, thus the test garment was expected to be slightly loose. On the contrary, the test garment was found to be slightly tight.

It is worth noting that the t-test and the fit test are generally in agreement as the expectations of the impact on fit as predicted by the t-test were evident in the fit test, with the exception of the nape to bust point and across the back shoulder measurements.

TABLE 4.16: COMPARISON OF THE FIT TEST TO THE T-TEST FOR THE BRAND 1 BODY FORM SIZE 34

#	Body dimensions	Fit test		T-test	
		B1 (34)		Triangular body shape & B1 (34)	
		Evaluation scores	Interpretation	Mean difference	*(p)*
1	Nape to natural waist	7	Slightly short	1.08	0.0101
2	Natural centre back waist to hip	9	Too short	-0.28	0.2986
3	Nape to bust point	7	Slightly short	-0.88	0.0690
4	Bust point to waist	8	Short	-3.44	0.0000
5	Bust girth	9	Too tight	-8.8	0.0000
6	Natural waist girth	9	Too tight	-1.76	0.0274
7	Lower hip girth	3	Slightly loose	3.84	0.0002
8	Across back shoulders	8.5	Too tight	-3.32	0.0000
9	Back width	9	Too tight	-4.4	0.0000
10	Across chest	7	Slightly tight	-4.92	0.0000
11	Width of bust prominence	8	Tight	-4.12	0.0000
12	Bust extension	6	Satisfactory fit	0.32	0.1953
13	Buttock extension	3	Slightly loose	2	0.0000

Fit evaluation scale:

1 = Too long / loose *2 = Long / loose* *3 = Slightly long/loose* *4 = Satisfactory fit* ***5 = perfect***
6 = Satisfactory fit *7 = Slightly short/tight* *8 = Tight/short* *9 = Too short/tight*

Significant at $p \leq 0.05$.
The mean difference values show the differences between the measurements of the Swazi women and those of the body forms. Negative (-) values = Swazi measurements are smaller, and positive (+) values = Swazi measurements are greater.

4.7.2 A comparison between the fit test and the t-test for the size 34 brand 1 body forms

Triangular body shape:

The comparison between the fit test and the t-test for the size 34 brand 1 body forms is presented in Table 4.16. The t-test indicated that there was a significant difference for the **bust point to waist, bust girth, natural waist girth, across back shoulders, back width, across chest, nape to bust point** and **the width of bust prominence** measurements. The mean differences for these dimensions were all negative, implying that the Swazi women were smaller at these dimensions and therefore the test garment was expected to be short or tight at these areas. The fit test confirmed this expectation as it was found to be tight at all these dimensions.

With regard to the **lower hip girth** and the **buttock extension**, the t-test indicated that there was a significant difference between the measurements for Swazi women and those for the body forms. The mean differences were positive at both these dimensions, implying that the Swazi women were found to be bigger compared to the body forms, thus the test garment was expected to be loose. This was indeed the case as the fit test found the test garment to be loose at these dimensions, thus the two tests yielded similar results.

There was an insignificant difference between the measurements for the Swazi women and those of the body forms at the **bust extension** as the mean difference was only 0.32 cm, which is too small to have an impact on fit at this dimension. The implication of the t-test is that, although the Swazi women are very slightly bigger, the difference is too small to have an effect, therefore the fit test was expected to yield a good fit. The test garment was found to have a satisfactory fit but with a score of 6, implying that the garment was more aligned to tightness. This may be attributed to the fact that the test garment was too tight at the bust girth, thus slightly affecting the fit of the bust extension.

There was a discrepancy between the findings of the t-test and the fit test with regard to the **nape to natural waist** measurement. The test garment was found to be slightly short, yet the Swazi women were found to be significantly taller by 1.08 cm, implying that the test garment was expected to be longer than the body forms. The fit test therefore yielded findings that were contrary to the findings of the t-test. The **natural centre back waist to hip dimension** for the Swazi women was found to be insignificantly short by 0.28 cm compared to the body forms. The fit test on the other hand found the test garment to be too short at this dimension, yet the difference between the Swazi women and the body forms was a mere 0.28 cm. This slight discrepancy can be attributed to the fact that the nape to natural waist measurement for the test garment was short, the effect on fit rippled to the natural centre back to hip dimension since the test garment was a dress.

TABLE 4.17: COMPARISON OF THE FIT TEST TO THE T-TEST FOR THE BRAND 2 BODY FORM SIZE 32

#	Body dimensions	Fit test		T-test	
		B2 (32)		Triangular body shape & B2 (32)	
		Evaluation scores	Interpretation	Mean difference	*(p)*
1	Nape to natural waist	8	Short	-2.37	0.0000
2	Natural centre back waist to hip	9	Too short	0.67	0.0133
3	Nape to bust point	7	Slightly short	-1.07	0.0066
4	Bust point to waist	9	Too short	-3.43	0.0000
5	Bust girth	9	Too tight	-2.03	0.0006
6	Natural waist girth	8	Tight	1.93	0.0030
7	Lower hip girth	2	Loose	15	0.0000
8	Across back shoulders	8	Tight	-1.87	0.0002
9	Back width	8	Tight	1.73	0.0000
10	Across chest	5	Perfect fit	0.53	0.0250
11	Width of bust prominence	5	Perfect fit	-0.4	0.1169
12	Bust extension	8	Tight	-1.8	0.0000
13	Buttock extension	1	Too loose	3.23	0.0000

Fit evaluation scale:

1 = Too long / loose *2 = Long / loose* *3 = Slightly long/loose* *4 = Satisfactory fit* ***5 = perfect***
6 = Satisfactory fit *7 = Slightly short/tight* *8 = Tight/short* *9 = Too short/tight*

Significant at p ≤ 0.05. The mean difference values show the differences between the measurements of the Swazi women and those of the body form. Negative (-) values = Swazi measurements are smaller, and Positive (+) values = Swazi measurements are greater.

4.7.3 A comparison between the fit test and the t-test for the size 32 brand 2 body form

Triangular body shape:

The comparison between the fit test and the t-test for the size 32 brand 2 body forms is presented in Table 4.17. The test garment was found to be short at the **nape to natural waist and the bust point to waist** measurements and slightly short at the **nape to bust point**. The t-test indicated that the measurements for both the dimensions were found to be significantly different, with a mean difference of -2.37 cm for the nape to natural waist, -3.43 cm for the bust point to waist measurement, and -1.07 cm for the nape to bust point. This implies that the Swazi women are shorter at these dimensions and therefore the test garment was expected to be shorter. Since the test garment was indeed found to be short, the t-test and the fit test are therefore in agreement in their findings pertaining to these dimensions.

The test garment was found to be too short at the **natural centre back waist to hip** dimension. The t-test on the other hand indicated a significant difference with a mean difference of 0.67 cm between the Swazi women and the body forms, implying that the Swazi women were slightly longer at this dimension. The expectation therefore was that the test

garment would be slightly longer at this dimension, which was not the case as the test garment was found to be too short at this dimension. It should be noted however that the fit of the nape to natural waist is highly correlated to the fit of the natural centre back waist to hip measurement in dress styles. Since the nape to natural waist dimension was found to be short, the waistline level was raised above position, thus affecting the fit of the natural centre back waist to hip dimension by raising it above its position, thus making it too short.

The t-test indicated that there was a significant difference and negative mean differences in the **bust girth**, **across back shoulders** and **bust extension**. This implies that the measurement differences are expected to have an impact on the fit of the test garment. Since the mean differences were negative it means the Swazi women are smaller at these dimensions compared to the body forms. It was therefore expected that the test garment would be tight to a certain extent. This expectation was confirmed by the fit test as the test garment was indeed found to be tight at these dimensions.

The test garment was found to be loose at the **lower hip girth** and the **buttock extension dimensions**. While the t-test indicated significant differences between the measurements for Swazi women and those for the body forms with positive mean differences, which implied that the Swazi women were bigger at these dimensions. Since the Swazi women were shown to be bigger at these dimensions it was therefore expected that the test garment would be loose on the body forms. The t-test and the fit test were therefore in agreement as they yielded the same results.

The test garment appeared to have a perfect fit at the **across the chest** and **width of bust prominence** measurements. The t-test indicated that there was no significant difference between the measurements for the Swazi women and the body forms at the width of bust prominence, hence the perfect fit at this dimension. Though a significant difference was noted with regard to the across the chest measurement, the mean difference was however too small (0.53 cm) to have an impact on the fit of the test garment, hence the perfect fit.

There was a discrepancy between the findings of the t-test and the fit test with regard to the **back width** measurement. The t-test indicated a significant difference with a mean difference of 1.73 cm, meaning that the Swazi women were slightly broader at this dimension, thus the test garment was expected to be slightly loose at this dimension. On the contrary, the test garment was found to be tight at this dimension. This may however be attributed to the repercussions of the small bust girth which then affected the fit of the back width, as the test garment gaped from the bust area, making it difficult for the edges of the centre back to meet.

There was a disparity between the findings of the t-test and the fit test with regard to the **natural waist girth** as it was found to have a tight fit, yet the test garment was 1.93 cm wider than the body form at this dimension, thus it was expected to be slightly loose. This difference can be attributed to the short nape to natural waist measurement, which ultimately pulls the waistline up (above its position) to where the body is slightly broader. Thus the waist appears to be broader as it is not positioned at the natural position.

TABLE 4.18: COMPARISON OF THE FIT TEST TO THE T-TEST FOR THE BRAND 2 BODY FORM SIZE 34

#	Body dimensions	Fit test		T-test	
		B2 (32)		Triangular body shape & B2 (32)	
		Evaluation scores	Interpretation	Mean difference	*(p)*
1	Nape to natural waist	8	Short	-1.92	0.0003
2	Natural centre back waist to hip	9	Too short	0.72	0.0174
3	Nape to bust point	7	Slightly short	-0.88	0.0696
4	Bust point to waist	8	Short	-4.44	0.0000
5	Bust girth	9	Too tight	-2.8	0.0012
6	Natural waist girth	9	Too tight	1.24	0.1461
7	Lower hip girth	2	Loose	11.84	0.0000
8	Across back shoulders	8	Tight	-1.32	0.0032
9	Back width	9	Too tight	0.6	0.0777
10	Across chest	6	Satisfactory fit	-0.92	0.0012
11	Width of bust prominence	7	Slightly tight	-1.12	0.0098
12	Bust extension	8	Tight	-0.68	0.0120
13	Buttock extension	2	Loose	3	0.0000

Fit evaluation scale:

1 = Too long / loose *2 = Long / loose* *3 = Slightly long/loose* *4 = Satisfactory fit* ***5 = perfect***
6 = Satisfactory fit *7 = Slightly short/tight* *8 = Tight/short* *9 = Too short/tight*

Significant at $p \leq 0.05$. The mean difference values show the differences between the measurements of the Swazi women and those of the body forms. Negative (-) values = Swazi measurements are smaller, and positive (+) values = Swazi measurements are greater.

4.7.4 A comparison between the fit test and the t-test for the size 34 brand 2 body form

Triangular body shape:

The comparison between the fit test and the t-test for the size 34 brand 2 body form is presented in Table 4.18. The test garment was found to be slightly short at the **nape to bust point** and short at the **nape to natural waist and bust point to waist** dimensions. The t-test indicated that there was a significant difference between the measurements for Swazi women and the body forms at nape to natural waist and bust point to waist. The mean differences were negative, implying that the Swazi women were shorter at these dimensions,

hence the test garment was expected to be short at these dimensions – and indeed it was short. There was no significant difference at the nape to bust point dimension, with a mean difference of -0.88 cm. Though the difference was insignificant, it nevertheless did have a slight impact on fit as the test garment was found to be slightly short. These findings demonstrate that the fit test yielded results that were expected from the predictions of the t-test.

At the **natural centre back waist to hip** dimension the test garment was found to be too short. The t-test indicated a significant difference with a mean difference of 0.72 cm between the Swazi women and the body forms, implying that the Swazi women were slightly longer at this dimension. The expectation was that the test garment would be slightly longer at this dimension, which was however not the case, as the test garment was found to be too short at this dimension. This may be attributed to the short nape to natural waist measurement which in turn raised the waistline above its position, thus affecting the fit of the natural centre back waist to hip dimension.

The t-test indicated that there was a significant difference and negative mean differences in the **bust girth**, **across back shoulders, width of bust prominence** and **bust extension** measurements of the Swazi women in relation to the body forms. These findings imply that the measurement differences are expected to have an impact on the fit of the test garment. Since the mean differences were negative it means the Swazi women were smaller at these dimensions compared to the body forms. It was therefore expected that the test garment would be tight on the body forms. This expectation was confirmed by the fit test as the test garment was indeed found to be tight at these dimensions.

The test garment was found to be loose at the **lower hip girth** and the **buttock extension dimensions**. The t-test indicated significant differences between the measurements for Swazi women and those for the body forms with positive mean differences, which implied that the Swazi women were bigger at these dimensions. Since the Swazi women were shown to be bigger at these dimensions it was therefore expected that the test garment would be loose on the body forms. The t-test and the fit test are therefore in agreement as they yielded the same results.

There was a discrepancy between the findings of the t-test and the fit test with regard to the **back width** measurement. The t-test indicated an insignificant difference with a mean difference of 0.6 cm, meaning that the measurement difference between the Swazi women and the body forms was too small to have an impact on fit, thus the test garment was expected to have a good fit of perhaps 5.5 or a satisfactory fit of 6, as the Swazi women were

slightly broader by 0.6 cm; yet on the contrary, the test garment was found to be too tight at this dimension. As noted earlier, this may be attributed to the small bust girth which then affected the fit of the back width as the test garment gaped over the bust area, making it difficult for the edges of the centre back to meet.

The test garment was found to have a satisfactory fit **across the chest** dimension, while the t-test indicated a significant difference between the measurements of the Swazi women and those of the body forms. The mean difference was -0.92 cm, implying that the Swazi women were slightly narrower at this dimension; therefore the test garment was expected to be slightly tight. However, since the mean difference was small, the test garment had a satisfactory fit which was a bit tight – as was to be expected.

There was yet a disparity between the findings of the t-test and the fit test with regard to the **natural waist girth**, as also reflected in size 32 brand 2. It was found to have a very tight fit, yet the test garment was 1.24 cm wider than the body form at this dimension, hence expected to be slightly loose – yet the opposite was true. As mentioned above, this is as a result of the short nape to waist dimension, which in turn offsets the waistline from its natural position toward the rib cage which is wider than the waistline, thus the waistline appears to be too tight.

In summary it was evident from the results that young Swazi women are prevalently triangular in body shape. In addition to the distinct triangular shapes, i.e. the hourglass, rectangular and – the least common – the inverted triangle, other less common body shapes also emerged. The two brands of body forms were each found to bear a unique shape and different measurements for the key dimensions compared to each other. One brand was found to be triangular in shape, while the other brand was found to be hourglass/ideal shaped. The results indicate that Swazi women were generally found to have significantly different measurements and proportions to those of either of the body forms in the same size category, hence predictable fit problems were anticipated. The results further indicated that the fit of the test garment on the body forms generally did not reflect a good fit. Based on the t-test, areas that were seen as possible sources of fit problems were indeed found to be sources of fit problems by the fit test, with a few discrepancies.

The results and discussions delved into in this chapter were consistent with the data for the research and form a prelude to the conclusions that were drawn from these results. In light of the results and the limitations of this study, pertinent conclusions and recommendations are made in the following chapter.

CHAPTER 5
CONCLUSIONS, EVALUATION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter presents the conclusions, evaluation, implications and recommendations for the study, as well as suggestions for future studies to explore this phenomenon further.

5.2 CONCLUSIONS

Anthropometric techniques and traditional tailor's measurements were used to obtain body measurements for various dimensions of a group of young Swazi women. A total of twenty three (23) measurements were obtained from a sample of 101 women in sizes 32 and 34. The young women were aged between 18 and 30 years, with the majority (75.3%) aged between 20 and 23 years. This conclusively implies that the young women were fully developed and had reached complete physical growth of full height, appropriate weight and fully developed body organs, thus the body shapes they exhibited were authentic. The sample of the participants originated from the four regions in Swaziland, with most (40.6%) from the Manzini region and the least (10%) from the Lubombo region, thus all the regions were reflected. Young Swazi women are of medium height to short and generally have higher height proportions compared to the ideal height proportions, i.e. they have a high bust level, high waist and a high hip; thus it can be concluded that young Swazi women have a short torso and long legs. This height variation creates an optical illusion of tallness, whereas in reality they are short to average in height. These height attributes will tend to affect the fit of ready-to-wear apparel in terms of length as Swazi women will often have shorter length proportions and height. This implies that the bust, waist and hip levels of ready-to-wear apparel and that of apparel produced from the body forms will be lower on Swazi women. This assumption based on the height proportions of Swazi women was indeed confirmed by the fit of the test garment on the body forms. All the length dimensions for the test garment were found to be short on the body forms due to the fact that Swazi women have a short torso, as shown by the height proportions. This attests to the fact that good fit can only be realised through the use of body forms and sizing systems that represent the body proportions and body shapes of the women the garments are intended for. This is in

agreement with Salusso-Deonier (1989), who states that accuracy can only be attained through fit models, figure forms and sizing systems that represent the target population's sizes and body shapes. A normal body mass index is evident within the sampled population, mostly (60.4%) weighing within the 51-60 kg weight range, which implies that weight had very little influence in the body shape of the young Swazi women in the sample.

5.2.1 Conclusions with regard to the identification and description of the most prevalent body shapes of young Swazi women through body dimensions

It can be concluded that the body shape of young Swazi women is not homogenous but predominantly triangular, as the most prevalent body shape of the young Swazi women was the triangular body shape, followed by the hourglass body shape. The inverted triangular and rectangular shapes were the least common body shapes, while the apple body shape was not found within the group of young Swazi women. This is in agreement with the conclusion by Magagula and Zwane (2006) that Swazi women fall within four figure types, the most prevalent being the triangular or bottom-heavy shape. Furthermore, it attests to the opinion that there is variability in terms of body shapes within ethnic groups, as was the case with the young Swazi women. It is of interest to note that the pattern of the distribution of body shapes in terms of prevalence was also found within the Taiwanese female students (Fu, Connell & Molnar, 2003).

The physical attributes of the triangular shape identified within the group of young Swazi women fit the profile of a triangular shape as described in Rasband *et al*., (2006:24), where the triangular shape is said to be smaller above the waist and wider below the waist, with a low hip curve and a small bust. The triangular shape identified within the group of young Swazi women has a wide hipline in comparison to a small waistline, with the hipline measuring 34.5 cm more than the waistline, and a low hip curve as the low hip measures more than the hips. With regard to the hip type and the width of the shoulders in relation to the hips, the hips gradually and progressively curve outward from the waist and round out over the hip bone, while the hip width exceeds the shoulder width; thus it can be concluded that young Swazi women predominantly have narrow shoulders. Though the young Swazi women are predominantly triangular in shape in terms of their physical features and attributes, one notes with interest that the standards within the minimum and maximum range of the drop values for the Swazi women and western standards are not similar. The distinction for the triangle shape in western terms is that, if the hip is 5 cm or more wider than the bust, then the shape is said to be triangular; yet based on the sample for the young Swazi women, the distinction for the triangular shape is that if the hip is 9 cm or more wider than the bust, then the shape is triangular. One can therefore conclude that there is a

disparity between the cut-off points for the recommended standards within the minimum and maximum range of drop values based on ethnicity. This attests to the notion that there is variation in terms of body shapes between different ethnic groupings (Shin & Istook, 2007).

Based on the conclusions highlighted above, one can conclusively deduce that young Swazi women will experience fit problems with ready-to-wear apparel, as it is manufactured based on the ideal/hourglass shape; yet the young Swazi women are prevalently triangular shaped. This is also the case for plus-size Swazi working women, as they were found to experience many sizing and fit problems in clothes they buy from local retail outlets (Nkambule, 2010).

5.2.2 Conclusions with regard to the identification and description of the body shape of currently used body forms through body dimensions

The shapes of the two brands of body forms used in this study are not the same in terms of shape and body dimensions. One brand is triangular shaped, while the other brand is ideal-shaped and the measurements for all the key dimensions in size 32 and size 34 for brand 1 are different in brand 2 in both sizes. One can conclude therefore that body form brands are not identical in terms of shape and measurements for the same size category. A constant linear increment pattern is however common from one size to the next, i.e. from size 32 to size 34 in the key dimensions (bust, waist and hip). This constant incremental pattern embraces the assumption that human beings have mathematically proportional bodies and that they grow in proportional ways in a constant pattern in terms of width and length. This growth pattern is relatively true from birth to the age of about 15, after which the body may tend to grow taller and bigger, for instance around the waist (Winks, 1997; Ashdown, 2003; Pisut & Connell, 2007).

It can be concluded therefore that only one of the body form brands has the same body shape as the most prevalent body shape within the group of young Swazi women. As alluded to earlier, though that may be the case in terms of body contours, the drop values, waist to hip ratio, bust to hip ratio, and the level of buttock protrusion for the Swazi triangular shape is not similar to that of the triangular shaped body form. The young Swazi women had a slightly pronounced bust extension, smaller bosom, a flatter abdomen and wider hips. Based on these discrepancies, the young Swazi women were shaped significantly differently from the body forms currently used, and are expected to experience fit problems with clothing draped on either body form brand.

5.2.3 Conclusions with regard to the identification, description and comparison of the most prevalent body measurements and proportions of young Swazi women and those of currently used body forms

It can be concluded that the hourglass-shaped young Swazi women and the brand 1 body form were significantly different. With regard to the body lengths, the young Swazi women were shorter compared to the body forms; thus they will experience fit problems with the use of these body forms as the accuracy of body length is critical in enhancing apparel fit. With the exception of the bust girth, hip girth and lower hip girth only in size 32, the young Swazi women had smaller girths from the bust girth (size 34) to the lower hip girth compared to the body forms. A degree of looseness will therefore be experienced by young Swazi women with apparel produced using these body forms. The emerging narrow body widths of the young Swazi women attest to the small skeletal frame of the Swazi women. Contrary to the petite trend in the skeletal frame of the Swazi women, their lower hip in size 32 and buttock extension is noticeably much wider or well-padded and protruding.

As far as the hourglass-shaped young Swazi women and the brand 2 body forms are concerned, it can be concluded that there are significant differences. Swazi women apparently have shorter body lengths which will impact negatively on the fit of apparel produced using these body forms for Swazi women. From the lower waist girth to the lower hip girth, the young Swazi women were wider than the body forms, while they were smaller at the under-bust girth. It is therefore predictable from these measurement differences that Swazi women will experience tightness from below the waistline to the lower hip area. They may have to buy a bra one size smaller with a small cup, as the under-bust measurements were smaller and the bust protrusion for Swazi women was also smaller. There was very little difference in most of the width measurements, except for the back width measurement. It can be concluded therefore that very few to no fit problems emanating from the body widths are to be expected.

Regarding the triangular shaped young Swazi women and the brand 1 body form, it can be concluded that, compared to the brand 1 body forms, triangular shaped Swazi women have short length dimensions, thus the placement of the bust-line, waistline and hipline will be affected, and one may predict that it will not be aligned with the actual level on the body in both one-piece and two-piece styles. Young Swazi women are narrow above the waistline and slightly below the waistline, i.e. up to the upper hip girth. This is attested to by the narrow body widths and narrow upper girth measurements. Conspicuous looseness of garments made from the brand 1 body forms is therefore predictable on young Swazi women. However, Swazi women have wider and well-padded hips and more protruding buttocks,

thus they are expected to experience tightness around the hip area with garments made from the brand 1 body forms.

With regard to the triangular shaped young Swazi women and the brand 2 body form, it can be concluded that, compared to the brand 2 body forms, triangular shaped Swazi women generally have short length dimensions except at the natural centre back waist to hip measurements. It can be predicted that this may have fit implications on the placement of the bust-line, waistline and hipline in one-piece dress styles. Skirts may not be affected as the difference between the Swazi women and these body forms is minimal. The body forms are wider above the waistline and much smaller or narrower below the waistline in terms of girth measurements. Distinct looseness above the waistline and tightness below the waistline is therefore predictable in garments made from these body forms for young Swazi women.

In summary, it can therefore be concluded that the young Swazi women differed significantly from the two body form brands currently used, and that the major measurement differences can be perceived as sources of predictable fit problems within the group of young Swazi women.

5.2.4 Conclusions with regard to the testing and evaluation of the fit of the test garment which represents the body shape of the Swazi women on the body forms

The following conclusions may be drawn regarding the fit of the test garment that was constructed using the measurements of the most prevalent body shape of the young Swazi women (the triangular shape), when it was tested on the two brands of body forms employed in this study in size 32 and 34.

With regard to the brand 1 size 32 body forms, the fit of the test garment exhibits a good grain line orientation and the test garment appears symmetrical and hangs evenly balanced on the body form on all sides. The test garment has a good set at the bodice part of the test garment and poor set at the skirt part due to excessive looseness in the hip area. The structural lines of the test garment are well-aligned with the natural lines of the body form, including the curved lines. The test garment has short length measurements e.g. at the nape to natural waist, natural centre back waist to hip, and bust point to waist. This implies that young Swazi women have shorter proportions in terms of height compared to these body forms. The test garment has no fitting ease across the chest, at the back width and across the back shoulders as it is slightly tight at these body parts. There is excess ease at the buttock extension and lower hip girth as the test garment is too loose at these dimensions.

The measurements for the Swazi women and these body forms are more or less similar at the bust extension and bust girth, and similar at the nape to bust point and width of bust prominence dimensions, as the fit at these dimensions is satisfactory to perfect.

For the brand 1 size 34 body forms, the test garment is asymmetrical and has poor balance and poor set, and consequently has unwanted wrinkles radiating from the apex of the buttock area to the side waist area. The structural line orientation is imperfect except at the neckline, e.g. at the side seams, waistline and hipline which are not well-aligned to the natural lines of the body form, and the front bodice darts are not pointed to the apex of the bust, while the armhole is not well-aligned to the armhole of the body form.

The test garment has short length measurements, implying that young Swazi women are shorter in length compared to these body forms, e.g. the test garment was too short at the natural centre back waist to hip, and short at the bust point to waist dimensions, while it was slightly short at the nape to natural waist and nape to bust point. The test garment bodice part has no fitting ease to allow movement, e.g. at the bust girth and back width, natural waist girth, across the back shoulders, at the width of bust prominence and across the chest, while there is enough fitting ease at the buttock extension and the lower hip girth. The body measurements and silhouette for the Swazi women and these body forms are more or less similar at the bust extension, as is evident in the fact that the fit was satisfactory.

For the brand 2 size 32 body forms, the test garment has a good balance evident in the fact that it hangs evenly on all sides of the body form and thus appears symmetrical, especially at the front and side view. There is poor garment set at the back as shown by inappropriate wrinkles stemming from the side waistline. The straight and curved structural lines (with the exception of the neckline) are not well-aligned to the natural lines of the body form at the side seams, waistline and hipline. The front bodice darts on the other hand are well-aligned and are pointed to the apex of the bust.

The test garment has poor fitting ease at the bust girth, natural waist girth, across the back shoulders, back width and at the bust extension, while it has short lengths at the nape to natural waist, natural centre back waist to hip and bust point to waist, nape to bust point dimensions, which implies that young Swazi women are generally shorter in length compared to the body forms. The test garment has excess ease, resulting in sagging at the lower hip girth and the buttock extension dimensions. There is a perfect fit across the chest and the width of bust prominence, hence the body measurements and silhouette for the young Swazi women and that of the body forms were more or less similar at this dimension.

Finally, for the brand 2 size 34 body forms the fabric grain of the test garment appears symmetrical as the garment hangs evenly balanced on the body form on all sides. The bodice of the test garment has a good set shown by a smooth and even fit without any unnecessary wrinkles. The set on the skirt part of the test garment is not good as there are soft vertical folds from the waistline, hinting at an element of looseness around the hip area. The side seams are not well-aligned with the natural lines of the body form, while the curved seams (the neckline, armhole and waistline) follow the circular lines of the body parts they are intended to fit.

With regard to ease there is enough fitting ease across the chest, while it is insufficient at the back width and across the shoulder dimensions. There is absolutely no fitting ease and movement is thus inhibited at the bust girth, natural waist girth, bust extension and at the width of bust prominence. The test garment is slightly short at the nape to bust point and at the nape to natural waist, bust point to waist, and natural centre back waist to hip dimensions. The test garment is loose at the lower hip girth and buttock extension dimensions. One may conclude that the young Swazi women have shorter lengths and are smaller from the waist to the shoulders and wider at the hip area. This is evident in the fact that the test garment was generally shorter in length from the waist to the hip and from the bust to waist and nape to waist, while it was tight above the waistline and loose below the waistline.

It is worth noting that the t-test and the fit test are generally in agreement as the expectations regarding the impact on fit as predicted by the t-test were realised in the fit test, with a few exceptions. One can therefore conclude that fit problems or implications predicted based on measurement differences hold true as the fit test showed fit problems where they were expected.

A few disparities between the findings of the t-test and the fit test with regard to the back width measurement and the natural waist girth measurement are evident. These differences can be attributed to the generally short nape to natural back waist measurement for the young Swazi women compared to the body form measurements. The shortness of this length ultimately pulls the waistline up above its intended position to a slightly broader body area, causing the waistline to appear smaller. One can therefore conclude that it is critical that the length measurements (the bust to waist and nape to back waist measurements) in a two-piece dress style are accurate as the repercussions of inaccurate measurements at these dimensions has a ripple effect on the line orientation of other dimensions, e.g. the alignment of the waistline, hipline and waist to hip measurement. In addition to the critical accuracy of the body lengths, it is imperative that the shape and all the other body dimensions of the

body forms are representative of the target population in order to get minimal to no fit problems and satisfactory apparel fit.

5.3 EVALUATION OF THE RESEARCH

5.3.1 Quality of the results

An evaluation of the study was carried out in order to establish the quality of the results in terms of validity and reliability.

5.3.1.1 Validity

Content validity

To ensure the content validity of this study, that is the degree to which the instruments used measured the intended content area, all the key concepts in the conceptual framework were identified after a comprehensive review of the literature. This ensured that the sampled body dimensions were representative of the whole content area being studied. Content validity is determined by expert judgement or jury opinion (Dooley, 2001; De Vos, Strydom, Fouche & Delport, 2005:161; Gay *et al*., 2006). The formulated data collection form and instruments were subjected to scientific scrutiny by experts in the field, i.e. the supervisor and experts in the field of fashion and apparel.

Face validity

Face validity of the measuring instruments, i.e. the degree to which the instruments appear to measure what they claim to measure, was achieved by an initial screening procedure in the selection of measuring instruments. This process was undertaken after a thorough review of the relevant literature to determine which measuring instruments have been successfully used before. Since face validity is not a psychometrically sound way of establishing validity, as it is based on face value, it was strengthened by content validity (Dooley, 2001; DeVos *et al*., 2005:161; Gay *et al*., 2006).

Consequential validity

To ensure consequential validity, that is the extent to which a measuring instrument creates harmful effects for the participants, the researcher observed during pilot testing to determine whether the measuring exercise and instruments had any adverse effects on the participants. Those that were observed (for instance, some participants preferred to have private

changing rooms instead of undressing in front of the other participants) were addressed accordingly before the actual data collection. Ethical concerns to some extent also addressed consequential validity as the participant's name was not used, but each participant was assigned a code and the measuring process was done in a room that afforded the participants privacy (Dooley, 2001; DeVos *et al*., 2005:162; Gay *et al*., 2006; Fraenkel & Wallen, 2006).

Internal validity

To address internal validity, which refers to the degree to which the methods and procedures used to generate the results can be trusted or are credible, the researcher underwent training for data collection in anthropometry, specifically on how to take body measurements accurately and on how to identify and locate body landmarks. To ensure that the participants were adequately described and identified, the selected participants accurately fitted the described target population, i.e. young Swazi women, and the researcher ensured that there was no bias in the selection of subjects, e.g. the inclusion of only women with a typical African shape/bottom-heavy figure type. Furthermore, the researcher ensured that the measuring session was not too long, as taking body measurements needs a high level of precision and accuracy which could tire the participants and researcher/measurer and thus compromise accuracy, for instance through bad posture and taking measurements only once instead of three times to find a mean.

In consumer science research, it is impossible to have a tightly controlled environment and to monitor all events, as one is normally dealing with people, not objects. The researcher tried to have very little time elapsing between the start and the completion of data collection so as to control drastic changes (Dooley, 2001; Baker, 1999). The measuring procedures were standardised so that the same observational instruments were used throughout the research, as a change of instrumentation such as a switch to more advanced accurate technology would have introduced a potential threat to the internal validity.

5.3.1.2 Reliability

To ensure the reliability of the study the participants were given cover letters informing them of the purpose of the research, which was further verbally expressed by the researcher in person. A strong rapport was developed and maintained with the participants to enable them to be at ease during the measuring session. The participants were assured of anonymity and confidentiality in order to inspire confidence, which was done by using codes for each data collection form instead of the participant's name, and only the researcher and her assistant had access to the data.

The data was authentic and trustworthy as the researcher/measurer underwent initial training on measurement techniques, body land marking and practised while being observed by the trainer – and was corrected if needed. A dry run for the body measurement procedures with subjects who were not part of the sample was carried out to determine competence in taking the measurements. After the evaluation of the dry run of the body measurement session, the progression and ease of the measuring exercise were refined as needed and general problems of a poor flow plan were resolved (Lohman *et al.,* 1988). Each measurement was taken three times and the average was used.

5.3.2 Ethical issues

The participants agreed to take part in the study by signing a consent form after they were given a thorough account of the nature of the study, as well as the main objectives and significance of the study to ensure that they gave an informed consent and were not coerced to be part of the study. To ensure that the participants were comfortable in taking part in the study throughout the measuring exercise, they were given the freedom to withdraw from the study at any time they felt the need to do so. To ensure that the privacy of the participants was not invaded in any way during the measuring sessions, the measuring was done in a quiet room, with only the measurer and the research assistant present and without any spectators, thus each participant was afforded privacy.

For uniformity in the dress code worn during the measuring session and for hygienic purposes, during the measuring exercise the participants wore a two-piece body suit supplied by the researcher, which was laundered after each use and packed before it was used by another participant.

To ensure and assure the participants that the data was kept confidential, once the data had been collected the researcher made sure that no one else, other than the researcher and the research assistant had access to the data. The names of the participants in this study have no significance, thus they were not reflected in any of the data collection forms. This was done by assigning a number (code) to each form to ensure that the information (data) furnished could not be linked to a particular subject. Furthermore, the researcher assured all the participants that all the data collected from or about them would be held in confidence and could not be traced back to them. Their names will never be used in any publication that describes the research.

5.4 CONTRIBUTION TO THEORY

This study contributed to the knowledge about the body shapes of the young Swazi women. Young Swazi women do not all conform to the same body shape, i.e. there is variation in terms of body shapes within this stratum of women, with the most prevalent shape being the triangular body shape. It is imperative therefore that apparel manufacturers are cognisant of this fact and apply it in the production of apparel for Swazi women, to ensure a better fit, as ready-to-wear apparel is traditionally manufactured using the ideal/hourglass body shape – contrary to the body shape prevalent among the young Swazi women.

The study shows that body form brands do not bear the same shape and their measurements vary within the same size categories from one brand to the next, i.e. a size 32 in one brand does not necessarily have the same measurements as another brand in the same size. Fit will therefore be dependent on the body form brand that an apparel manufacturer happens to use. This translates into longer fitting sessions in retail outlets to ensure that the garments fit, instead of purchases based on the size category – which means that the sizing system used is meaningless as the size tags are not helpful in finding apparel that fit. Only those body forms closer in terms of body shape and size to the target population will offer better levels of fit.

The study gives an in-depth delineation of the fit problems that will be experienced by young Swazi women in the different areas of the body that were under scrutiny as a consequence of differently conformed and sized body forms being used in the production of apparel. The study therefore highlights the fact that there is a need for stakeholders in the apparel industry i.e. designers, pattern makers and apparel manufacturers, to understand their target population thoroughly in terms of shape, proportion variations, size and general figure variations, and to reach consensus in their understanding in order to afford a better fit.

5.5 IMPLICATIONS AND RECOMMENDATIONS

There was a clear indication from the results that the prevalent body shape of young Swazi women is not similar to that of the body form brands currently used in apparel manufacturing. Though one of the body forms was found to bear the same body shape as the prevalent triangular body shape of young Swazi women, upon further investigation a disparity was evident in terms of size. The young Swazi women were found to be much wider and

extended around the hip and buttocks area and narrower above the waistline, thus rendering the body form dissimilar in terms of body measurements and contouring.

The results further indicated significant differences in the measurements of the different body dimensions of the body forms and those of the young Swazi women. The measurement differences are having adverse fit implications for Swazi women that manifest as fit problems encountered with apparel produced using the body forms. When the fit of the test garment produced using the measurements of the body shape prevalent among the young Swazi women was tested on the body forms, the fit was generally found to be too short/tight or too loose, and seldom perfect.

From the review of the relevant literature on sizing and fit, it is clearly evident that an efficient sizing system is only possible when, amongst other factors, accurate body measurements of the different body shapes of a target population are used (Istook & Hwang, 2001; Ashdown, 2003). It is therefore recommended that all stakeholders in the apparel industry, which is comprised of clothing manufacturers, pattern developers, apparel designers, apparel retailers and apparel consumers, work together to address sizing and fit issues and so ensure the standardisation of measurements and size categories. There is a need for transparency in terms of the sizing systems and body form shapes and brands used; all the relevant stakeholders should strive to reduce the ambiguity that exists in the industry, leading to different manufacturers using their own standards and thus compounding the problem.

To ensure that apparel stakeholders across the board make informed decisions that will ultimately afford the Swazi women better fitting apparel, it is highly recommended that the awareness and comprehension of the impact of sizing, shape of the body forms and target market body shapes on fit, are extensively promoted, for instance through workshops and dissemination of research findings that have a bearing on fit issues. Consequently the comprehension of the impact of sizing and body form shape begs the recommendation that apparel manufacturers use body forms that are shaped like the target market population to improve the levels of apparel fit. There is a dire need for consumers to be schooled on the different body shapes that exist within the consumer populations to help them attempt to identify which body shape they are more aligned to. For tailor-made garments, consumers can then proactively guide the designer on the shape of the body form to use and on which styles would therefore be suitable to minimise fit problems.

The Swaziland Standards Authority (SWASA) and the University of Swaziland as a research institution have a major role to play in the development of and the adherence to standards of a sizing system that is based on the anthropometric data of Swazi women. Currently the

sizing system that is used is based on British anthropometric data that is decades old (Magagula & Zwane, 2006). This move would lead to the development of body forms that reflect the prevalent body shapes of Swazi women to be used in the production of apparel for Swazi women that would have good fit.

5.6 LIMITATIONS AND SUGGESTIONS FOR FUTURE STUDIES

Sizing and fit problems have plagued the apparel manufacturing industry and consumers for a very long time now, and unless the existing shortcomings of the sizing system and ultimately the body forms developed based on the sizing system are properly addressed, these fit problems will continually be faced by young Swazi women. Ignorance of the impact of figure variations between and among different ethnic groupings on sizing and fit translates to inconsistent measurements for similar size categories in body form dimensions, and perpetuates the practice of having to try on many different sizes to overcome variations. Though this study was limited to a relatively small sample of young Swazi women, sizing and fit issues are pertinent to a wider spectrum of the Swazi population in terms of shape, size, age and gender. There is therefore a need to repeat the same study on a larger scale that is focused on more size categories, more age ranges and more body form brands.

Population measurements are vital for the identification of body shapes as fit problems cannot be addressed without a set of accurate body measurements (Istook & Hwang, 2001). Consequently therefore, to address the fit problems faced by today's Swazi consumers, a comprehensive anthropometric study of today's population needs to be undertaken in Swaziland to yield a measurement data bank for all the consumer profiles. In addition to the identification of shape variations, the study should also aid in identifying all other figure variations, e.g. posture and back variations, shoulder slopes, bust and buttock extensions and body proportions. A prototype of a body form, shaped and sized as the most prevalent body shape (Swazi triangular) of young Swazi women should be developed and used to produce apparel for young Swazi women. A study on the problems, sizing and fit of apparel produced using this body form prototype can then be done and the results compared with those of the body forms currently used. With regard to the test garments to be used in the proposed studies, it is suggested that a two-piece, i.e. a bodice and separate skirt, should be used to address the limitations of the one-piece test garment dress. The separated two-piece garment will show the location and alignment of the key dimensions, i.e. bust, waist and hip clearly, as the short lengths will not tamper with the placement of the above-mentioned key dimensions – as was shown in the present study.

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ADDENDUM A

LETTER OF CONSENT

LETTER OF CONSENT

Dear Participant

I am conducting a study on the Body shape analysis of Swazi Female consumers to improve Body Forms for the Small Apparel Manufacturing Industry in the country. The purpose of the study is to ascertain a comprehensive profile of young Swazi women. This will be done in terms of body dimensions, body proportions and body shape in a bid to improve the shape and proportions of the currently used body forms, hence afford better fit for Swazi women.

I request that you give your consent (below) to take part in the study as participation is based on a voluntary basis. If however during data collection you feel unfit or uncomfortable for further participation, you may withdraw from the study at any time you feel the need to do so.

I give my consent to participate in the study: YES/ NO

Signature: _____

ADDENDUM B

BODY MEASUREMENT FORM FOR SWAZI WOMEN

BODY MEASUREMENT FORM FOR SWAZI WOMEN

Region	
Subject number	
Age	
Weight	
Garment size	

Measurements to be recorded (in cm)				
A	**Height and vertical measurements**			
1	Height (stature)			
2	Nape to ground (vertical height standing)			
3	Shoulder to ground			
4	Natural waist to ground			
5	Hip to ground			
6	Nape to natural waist			
7	Centre back waist to (natural) hip			
8	Nape to bust point (cervical to breast point)			
9	Bust to waist			
B	**Horizontal (Girth) measurements**			
10	Neck base girth			
11	Bust girth			
12	Under-bust girth			
13	Natural waist girth			
14	Lower waist girth			
15	Upper hip girth (about 10 cm below natural waist)			
16	Hip girth			
17	Lower hip girth			
C	**Width and length measurements**			
18	Across back shoulder			
19	Back width			
20	Across chest at the front (midway between neck base and scye level)			
21	Width of bust prominence			
22	Bust extension			
23	Buttock extension			

ADDENDUM C

BODY MEASUREMENT FORM FOR BODY FORMS

MEASUREMENT FORM FOR BODY FORMS

Brand	
Garment size	

Measurements to be recorded (in cm)				
A	**Height and vertical measurements**			
1	Height (stature)			
2	Nape to ground (vertical height standing)			
3	Shoulder to ground			
4	Natural waist to ground			
5	Hip to ground			
6	Nape to natural waist			
7	Centre back waist to (natural) hip			
8	Nape to bust point (cervical to breast point)			
9	Bust to waist			
B	**Horizontal (Girth) measurements**			
10	Neck base girth			
11	Bust girth			
12	Under-bust girth			
13	Natural waist girth			
14	Lower waist girth			
15	Upper hip girth (about 10 cm below natural waist)			
16	Hip girth			
17	Lower hip girth			
C	**Width and length measurements**			
18	Across back shoulder			
19	Back width			
20	Across chest at the front (midway between neck base and scye level)			
21	Width of bust prominence			
22	Bust extension			
23	Buttock extension			

ADDENDUM D

FIT STANDARDS/GUIDELINES FOR FIT EVALUATION

SET OF FIT STANDARDS USED AS GUIDES FOR THE FIT EVALUATION EXERCISE

#	Body measurement	Standard/guideline
1	**Nape to natural waist**	The centre back neck point should be at the nape and the centre back should extend to the centre back waistline level. There should be no tight vertical wrinkles that signal shortness.
2	**Natural centre back waist to hip**	The waistline should lie at the waist level and the hipline should lie at the hip level and should be perpendicular to the floor. The waistline and hipline should not shift up or be pulled down below level.
3	**Nape to bust point**	The centre back should be centred at the back of the body with the C.B. neck point at the nape. The neckline should fit the curve around the base of the neck, without cutting into the neck, wrinkling or gaping. The bust point should be aligned with the apex of the breasts.
4	**Bust point to waist**	The darts should point toward and end about 1 to 1.5 inches from the bust point, with no wrinkle or bubble at the dart tip. The base of the dart should rest at the waistline level with no horizontal wrinkles or bulge.
5	**Bust girth**	The dress should fit comfortably snug around the bust area and level with the floor. There should be no folds or creases radiating from the fullest part of the bust curve or loose folds or bubbles around the bust area.
6	**Natural waist girth**	The dress should fit comfortably snug at the natural waistline when standing and level with the floor. There should be no horizontal fold or crease around the waist and below the waist.
7	**Lower hip girth**	The garment should fit loosely enough for the fabric to relax and lie smoothly on the body. There should be no horizontal fold or crease at the hip joint. The skirt should fall straight down below the abdomen and hipline, rather than cupping under the stomach or buttocks.
8	**Across back shoulders**	The armhole seamline should cross the shoulder at the shoulder joint and should appear in line with the back arm crease.
9	**Back width**	Should lie smooth, without wrinkles or strain at the arm scye seams when arms are forward. There should be no horizontal wrinkle, bulge or bubble below the collar.
10	**Across chest**	There should be no loose horizontal sagging wrinkles. The garment should lie smooth, without wrinkles or strain at the arm scye seams when arms are forward.
11	**Width of bust prominence**	The tip of the darts should point toward the bust point and they should not shift or pull to the centre front or side seam.
12	**Bust extension**	The dress should fit comfortably snug at the bust area when standing. There should be no folds or creases radiating from the fullest part of the bust curve or loose folds or bubbles around the bust area.
13	**Buttock extension**	There should be no horizontal fold or crease at the hip joint or folds radiating from the crown of the buttocks. The skirt should fall straight down below the hipline, rather than cupping under the buttocks.

Source: adapted from the standard guidelines for a fabulous fit by Rasband & Liechty (2006:61)

ADDENDUM E

FIT ASSESSMENT FORM

FIT ASSESSMENT FORM

Body form brand _____ **Size** _____

Scale for Questions: 1 - 9
1 = too loose/long 5 = perfect fit 9 = too tight/short

1	Nape to natural waist								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
2	Natural centre back waist to hip								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
3	Nape to bust point								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
4	Bust point to waist								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
5	Bust girth								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
6	Natural waist girth								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
7	Lower hip girth								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
8	Across back shoulders								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
9	Back width								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
10	Across chest								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
11	Width of bust prominence								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
12	Bust extension								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short
13	Buttock extension								
	1	2	3	4	5	6	7	8	9
	Too long				Perfect fit				Too short

Source: Adapted from the fit evaluation scale by Yu et al, in Yu. (2004: 39)

ADDENDUM F

AMOUNT OF EASE GUIDELINES

AMOUNTS OF EASE

Body measurements	Amount of ease (cm) Close-fitting	Amount of ease (cm) Fitted
Bust	0.5 - 2	2 - 4
Waist	0.5 - 2	2 - 3
Hip	0.5 - 2	2 - 3
Across back	0.5 - 0.75	0.75 - 1.25
Shoulder seam	0 - 0.25	0.25 - 0.5
Armhole	1 - 2	2 - 3
Chest	0.5 - 2	2 - 4

Source: Myers-Mcdevitt (2004:332)

ADDENDUM G

FIT DESCRIPTORS

FIT DESCRIPTIONS

1	=	Too long/loose
2	=	Long/loose
3	=	Slightly long/loose
4	=	Satisfactory fit
5	**=**	**Perfect fit**
6	=	Satisfactory fit
7	=	Slightly long/loose
8	=	Tight/short
9	=	Too short/tight