Body shape characteristics, body cathexis and apparel fit preferences and problems of African and Caucasian women

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by

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This work is dedicated to my late mother Mrs Saraphinah H Makhanya and my father Lucas N Makhanya, who invested in my education and laid a foundation on which this work is built. They taught me to strive for excellence in everything I do. To my daughters Bongekile Elif S'ncedzile and Sisekelo Tapua Nkosim'londile, you propelled me to soar to even greater heights; I love you girls!

DECLARATION

I, Bukisile P Makhanya, hereby declare that this thesis which I submit for a PhD degree in Consumer Science: Clothing Management at the University of Pretoria, is my original work and has not previously been submitted for a degree at any other University.

Bukisile P Makhanya

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ABSTRACT

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Apparel firms base their sizing systems on a standard figure. The South African apparel industry adapted an old British sizing system that is not only foreign but is also out dated and inaccurate. Consumer populations consist of varied body shapes and sizes. Yet the South African industry like a majority of apparel industries around the world does not cater for figure shape variations. Consequently, consumers whose body shape characteristics differ from the ideal figure are likely to experience fit problems from the standard apparel. Ready-to-wear (RTW) apparel fit problems are further compounded if the target population consists of diverse ethnic groups, as body shapes, sizes and proportions differ between ethnic groups. An individual's body shape characteristics and ethnicity influence one's body cathexis. Furthermore, consumers of different body shapes and ethnicity are likely to have different RTW apparel fit preferences. This research aimed to compare body measurements, measurement ratios, body cathexis, fit problems and fit preferences of 234 young African and Caucasian women selected by the purposive and snowballing techniques.

This descriptive and exploratory research employed quantitative techniques for collecting and analysing the data. The data was collected using a 3-D body scanner, a questionnaire and a Body Shape Assessment Scale. Virtual body images were generated, from which measurements were extracted. Thereafter, the drop values: hip minus bust and bust minus waist circumferences were used to classify participants into different body shape categories. Virtual images were then used to confirm and adopt the assigned body shapes. Descriptive

statistics, Chi-square and Kruskal-Wallis tests were used to compare body measurements, body cathexis, fit problems and fit preferences of the predominant African and Caucasian body shapes.

The three most predominant body shapes were the triangle, the hourglass and the rectangle in varying numbers among the African and Caucasian women, showing a significant association between body shapes and ethnicity ($p = 0.004$). A comparison of the body measurements of the predominant shapes with those of the Caucasian hourglass, assumed to be identical to the Western ideal figure used by the apparel industry, reveal that most differences that impact on apparel fit are between the Caucasian hourglass and the Caucasian triangle, the African hourglass and the African triangle. The present study also found body shape differences between African and Caucasian women of the same body shape, which strongly points to the role of ethnicity in body shape differences.

In most cases there were discrepancies between predicted and perceived fit problems. The Caucasian triangle experienced the predicted fit problems and apparel tightness around the hips and buttocks, which did not record significant differences. Even though the Caucasian rectangle did not differ much from the Caucasian hourglass, they experienced a too tight fit at the bust, stomach, abdomen, hips and thighs and not at the significantly larger waist where tight fit was predicted. Ethnicity proved to influence body shape characteristics as the African hourglass recorded a significantly smaller abdomen than the Caucasian hourglass and as predicted resulted in loose fitting skirts and trousers just below the waist. However, the African hourglass did not experience loose fit around the abdomen. The African triangular body shape had a significantly smaller bust, smaller abdomen, with larger hips, buttocks and thighs, and therefore, loose fitting in the waist of bodices and tight fitting in the lower body were as predicted. The African rectangular shape had a few minor differences compared to the Caucasian hourglass, yet they perceived a too tight fit at the bust, stomach, abdomen, hips and thighs although none of these were predicted from the body measurements.

The African hourglass was the only shape that was satisfied with all body parts, while other shapes were dissatisfied with most of the lower body parts. Although almost all the predominant body shapes mostly experienced a too tight fit at stomach and abdomen and lower body parts, all except the Caucasian rectangular, preferred closely fitted apparel at all body parts, despite their dissatisfaction.

This study therefore concludes that for improved fit, sizing systems, dress forms and fit models should be representative of the body shapes and body shape characteristics prevalent within consumer populations. The apparel industry must understand the apparel fit needs of their target markets, as apparel fit is subjective. Although the present study could not statistically test associations between the variables due to the sparse cell counts, the results clearly point to the role of body shape in perceived fit problems that may have influenced satisfaction with selected body parts. Furthermore, ethnicity may have influenced participants' cathexis, as the Caucasian body shapes were more dissatisfied than the African body shapes. It seems that body shape, fit problems, and body part cathexis did not influence participants' RTW apparel fit preferences, as all the body shapes expressed a preference for closely fitted apparel despite significant differences in body shape characteristics, different fit problems and cathexis levels.

The findings of this study add the body shapes, body parts cathexis, apparel fit problems and preferences of young African and Caucasian women to the existing global and local body of knowledge as important concepts in RTW apparel manufacturing.

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3-D:	Three-dimensional
CSIR:	Council for Scientific and Industrial Research
ISO:	International Organization for Standardization
NMMU:	Nelson Mandela Metropolitan University
US:	United States
USA:	United States of America
RTW:	Ready-to-wear
[TC]²:	Textile Clothing and Technology Corporation

CHAPTER 1: THE STUDY IN PERSPECTIVE

1.1 A SYNOPSIS OF THE SOUTH AFRICAN APPAREL INDUSTRY

The apparel industry has evolved from a simple to a sophisticated industry that provides style and quality apparel to consumers. In the early 19th century, the fashion industry produced custom-made apparel that fitted the individual it was made for (Stone, 2005:171). Contrary to custom-made clothes produced by professional dressmakers and home-sewers, ready-to-wear apparel is completely made in factories, produced in advance, based on companies' sizing systems, and is ready to be worn by consumers of different sizes and shapes (Burns & Bryant, 1997:102; Stone, 1999:179).The South African ready-to-wear (RTW) apparel consist of large and small to medium apparel manufacturers (Jauch, & Traub-Merz, 2006). Pre-democracy the industry focused on producing apparel for domestic markets that were not regulated by international standards (Jauch, & Traub-Merz, 2006). Post 1994, the South African apparel sector expanded and began venturing into international trade that exposed it to global competition (Ramdass, 2007). As a result, the South African Government challenged the apparel industry to be more competitive and proposed that among competitive priorities, they offer product differentiation i.e. supply unique apparel products and respond to consumer demands (Ramdass, 2007).

In the recent past, the South African RTW apparel industry experienced a decline due to global competition and unfavourable domestic operating conditions (Jauch, & Traub-Merz, 2006). The influx of cheaper RTW apparel product especially from China aggravated the situation (Ramdass, 2007) and resulted in the shutdown of some of the manufacturing companies. To sustain the few companies that were thriving, the South African government implemented the "Proudly South African" labels with the aim of persuading local shoppers to purchase South African products (Ronan, 2015). The apparel retail industry was also challenged to form financial links and strategic alliances with a number of large manufacturers in order to preserve their markets (Textiles Intelligence, 2014). Furthermore, in order to expand the domestic markets, the South African RTW apparel industry had to position itself to offer consistent apparel quality and respond to local consumer demands for apparel with good fit. However, studies conducted in South Africa (Strydom & De Klerk, 2006; Muthambi, 2012) show that without a South African sizing system that is based on a representative anthropometric data, it will be difficult to address the issue of ill-fit.

According to Muthambi (2012:18) the South African Bureau of Standards has never published a standard for sizing women's RTW apparel. The lack of standards in the South African RTW apparel industry has been a persistent challenge. Strydom (2006) gathered that some of the RTW apparel manufacturers and retailers used different methods and techniques to obtain body measurements and the body measurement surveys they conducted addressed fit concerns specific to their consumers, which does not curb the country wide problem of ill-fitting RTW apparel. Due to the limited documented scientific resources on RTW apparel manufacturing in South Africa, this study extrapolates issues facing the South African industry.

1.2 THEORETICAL BACKGROUND

According to Stone (1999:179) and Brown and Rice (2001:1), RTW apparel sizing is achieved by combining different companies' standardised body dimensions and sizing, wearing and design ease. Manufacturers base RTW pattern design and apparel production on measurements of an ideal figure. These measurements are graded, i.e. scaled up and down by equal constant proportions to provide sizes for the entire target population (Burns & Bryant, 1997:102; Stone, 1999:179; Brown & Rice, 2001:1; Le Pechoux & Gosh, 2002:21). An ideal figure is one that has a well-proportioned body, whose bust and hip circumferences are almost equal and a waist circumference that is about 25 cm smaller than both the hip and bust circumferences. Furthermore, an ideal figure has a medium bust, a small waist, flat to slightly curved abdomen, moderately curved buttocks and slim thighs (Rasband, 1994:12; Fan, 2004:4; Rasband & Liechty, 2006:24). Different companies base their apparel production on different standard/ideal figures, fit models and size charts, resulting in apparel of sizes differing from one manufacturer to the next. This has resulted in inconsistent apparel sizing and fit, and consequently ill-fitting apparel in the market (Kurt Salmon Associates, 2000; Le Pechoux & Gosh, 2002:4; Xu, Huang, Yu & Chen, 2002a; 2002b; Apeagyei, Otieno & Tyler, 2007; Shin & Istook, 2007). Consequently, over 50% apparel consumers in USA are failing to find well-fitting apparel (Kurt Salmon Associates, 2000; Alexander, Connell & Presley, 2005), yet fit is one of the main attributes consumers look for when purchasing RTW apparel (Anderson, Brannon, Ulrich, Presley, Waronka, Grasso & Stevenson, 2001; Stone, 2005:181).

The literature (Zwane & Magagula, 2006) indicates that generally, female consumer populations consist of consumers with body dimensions and shapes that are different from those of the ideal figure. Individuals with different body shapes are therefore likely to experience apparel fit problems from apparel produced based on the standard body measurements and shape of an ideal figure (standard apparel). This is partly because the ideal figure is not a common figure shape among apparel consumers, as on average, women have become larger and reflect a variety of body shapes and sizes (Simmons, Istook & Devajaran, 2004a; 2004b; Pisut & Connell, 2007). Moreover, female body shapes and proportions have evolved over the years as a result of nutritional changes, lifestyles, ethnicity and what is perceived as ideal beauty in the different cultures (Le Pechoux & Gosh, 2002; Fan, 2004:4; Zwane & Magagula, 2006).

Simmons *et al*. (2004a; 2004b), Lee, Istook, Nam and Park (2007) and Shin and Istook (2007) further observed that USA female populations consist of individuals with different body shapes within and between populations. It is expected that the body shapes of the South African female population be varied too as it also consists of varied ethnic groups. Findings by Istook, Simmons and Devarajan (2002), Simmons *et al*. (2004a; 2004b) indicate that of a sample of 222 respondents, 40% of the subjects were bottom-heavy hourglass, 21.6% hourglass, 17.1% spoon and 15.8% rectangular-shaped women. Another study by Li, Ulrich and Connell (2003) also found that of a sample of 45, the triangular shape was the most common at 40%, followed by 35% rectangular shape. Mastamet-Mason (2008:151) also found that among Kenyan (African) women there was a higher number of rectangle (74%), followed by triangle (21.5%) and hourglass (1.5%) shapes. In another African study, Mabuza (2012:103) found that the triangle was the most prevalent shape among Swazi (African) women. Furthermore, Lee *et al*. (2007) observed that the most prevalent body shape among US and Korean women was the rectangle and not the ideal/hourglass figure. It is therefore not surprising that apparel consumers continue to experience fit problems from standard apparel. This is because, even with variations and changes in body shapes, the apparel industry the world over still continues to base apparel manufacturing on measurements of the ideal figure. The resulting apparel therefore only properly fits consumers with similar shapes as the ideal body shape**.** Winks (1997) suggested that if good apparel fit is to be achieved, it is important for apparel manufacturers to re-evaluate prevalent body shapes within populations and to configure them with the population's measurements from time to time. It is therefore imperative to investigate how female body shapes and body shape characteristics of the ethnically diverse South African population compare to each other and to the Western ideal figure.

According to research (Devarajan & Istook, 2004; Petrova, 2007:57), the foundation of well-fitting RTW apparel for any target population should be accurate measurement of body dimensions combined with body shape classification into different figure shape categories. Thereafter, apparel companies need to base pattern design and apparel making on body measurements and body shapes of the most prevalent body shapes of the target population to ensure production of better-fitting apparel (Ashdown, 1998; Kwong, 2004:196; Pisut & Connell, 2007; Plutt, 2011:36).

1.2.1 Body shape classification

According to Ashdown's model, an effective sizing system classifies the target population into different body shapes according to similar body shape characteristics. Classification of body shapes lead to a better understanding of main body shape characteristics and body proportions within a population. The importance of classifying the body shapes prevalent within a population is emphasised by Connell, Ulrich, Knox, Hutton, Trent, Waronka, Bruner & Ashdown (2006), who argue that body shape does not depend on body size. Individuals vary from small to large or from short to tall within the same apparel size category and may have similar or different body shapes. Differently shaped bodies require different apparel base patterns. Therefore, when constructing RTW apparel for consumer populations with different body shapes, it is crucial that attention is directed at existing differences to minimise fit problems. Workman (1991) suggested that in order to minimise fit problems, pattern designs and apparel production must be based on the body dimensions of the most prevalent shapes within a population (Goldsberry, Shim & Reich 1996a; Anderson *et al.*, 2001; Alexander *et al*., 2005).

1.2.2 Body shape and ethnicity

As mentioned earlier, consumers within a target population have different body shapes, sizes and proportions (Lee *et al*., 2007), which are also different from the ideal figure. The presence of different ethnic groups within a population further aggravates figure shape variation, as was observed in the study by Shin and Istook (2007). Fit problems are further aggravated if the population consists of diverse ethnic groups (Brown, 1992:18; Kwong, 2004:198), as ethnicity influences body sizes, proportions, shapes and body shape characteristics of a population. An understanding of variations in body shapes and sizes by consumers and manufacturers is one possible way of addressing consumers' apparel fit problems (Connell *et al*., 2003; Lee *et al*., 2007). Therefore, it is believed that body shape variation in South African females may to a large extent be attributed to the diverse ethnic groups in South Africa. Ethnicity refers to segments or subcultures that differ in background, affinity, ancestry, language, history, religion, customs, normative patterns and heritage (Emslie, Bent & Seaman, 2007). Therefore it is necessary for RTW apparel manufacturers to identify and study body shapes and body shape characteristics prevalent within ethnically diverse populations, to determine how they differ from one another as well as from the ideal figure. This will further ascertain whether the use of standard apparel would give satisfactory fit across all the ethnic groups.

Furthermore, clothing manufacturers need to ascertain whether the differences in body shapes, size and body measurements of the different ethnic groups are significant, to determine whether RTW apparel designed to fit one ethnic group would also fit the other ethnic groups satisfactorily (Winks, 1991). However, if the differences in body shape and size of the different ethnic groups are significant, the standard apparel will result in apparel fit problems.

1.2.3 Body shape and apparel fit problems

Apparel industries are faced with a challenge to offer apparel consumers better fitting RTW apparel. The problem of ready-made apparel fit has gained a lot of attention as consumer demand for well-fitted apparel is increasing. Dissatisfaction with fit is however still one of the most frequently stated problems with garment purchases as women have been reported as the most dissatisfied consumers (DeLong, Ashdown, Butterfield & Turnbladh, 1993; Alexander *et al.*, 2005; Otieno, Harrow & Lea-Greenwood, 2005). Moreover, the apparel industry bases designs and production of RTW apparel on body shape and measurements of an ideal figure. Apparel fit problems among female consumers are caused by variations in body shapes, sizes and proportions of the female folk within a population.

Consumers need to understand how their body proportions and shapes compare to those of the ideal figure. That is, whether one's proportions are shorter or longer, narrower or wider than those of an ideal figure. This may enable them to make informed purchasing decisions (Marshall, Jackson, Stanley, Kefgen & Touchie-Specht, 2004:377; Rasband & Liechty, 2006:23), which may subsequently minimise apparel fit problems. Designers and manufacturers also need to understand the physical characteristics of the different body shapes in order to produce RTW apparel that will accommodate consumers' figure variations and meet their fit expectations.

However, according to Strydom and de Klerk (2006), as in most countries, the South African apparel industry does not produce RTW apparel for the varied body shapes. They continue to base apparel production on body shape and measurements of an ideal figure (Western hourglass), hence the persistent fit problems experienced. Shin and Istook (2007) further pointed out that since different ethnic groups have different body shape characteristics, they may also experience different RTW apparel fit problems from the standard apparel. LaBat and DeLong (1990) observed that when apparel does not fit well, women tend to blame their bodies. This is an aspect of body cathexis which may also be influenced by other factors such as consumers' body shape and body shape characteristics.

1.2.4 Body shape and body cathexis

Body cathexis is defined as satisfaction with one's overall body or parts thereof. It is an evaluation of body image and the perception of one's own body (Secord & Jourard, 1953). Negative or low body cathexis is an indication of one's dissatisfaction with one's body or parts thereof (Secord & Jourard, 1953). On the other hand, a positive or high body cathexis reflects one's satisfaction with one's body or parts thereof. The level of one's satisfaction with one's body influences how one perceives apparel fit (Secord & Jourard, 1953; Mahoney & Finch, 1976; LaBat & DeLong, 1990; Fan, 2004:10). As a result, consumers who are satisfied with their bodies or body parts are in most cases also more satisfied with apparel fit than those who are least satisfied with their bodies or body parts (LaBat & DeLong, 1990; Petrie, Tripp & Harvey, 2002; Robinson, 2003; Fan, 2004:11).

On the other hand, Pisut and Connell (2007) discovered that body satisfaction for women is closely related to body size and that it accounts for 60% of the overall satisfaction with appearance. Body size influences both self-esteem and perception of physical attractiveness, and consequently body cathexis, all of which may impact on an individual's perception of apparel fit. Even though a number of studies have explored the influence of consumers' body size and parts thereof on cathexis, their findings also hold true for different body shapes as body shape, size and body shape characteristics also differ by body shape, which may also impact on body cathexis. For instance, a triangular shape has a smaller upper body and a larger lower body, an hourglass has a smaller waist and average to large bust and hips, an inverted triangle is larger and wider above the waist and smaller below the waist. The rectangular shape is larger than average with an almost equal body from shoulders to hips. An apple shape has bust, midriff, waist, abdomen, buttocks, hips and upper legs larger and fully round. These body shape characteristics may influence one's body and body part cathexis (Rasband & Liechty, 2006:24-25).

Fan (2004:11) records that women with average body sizes (body measurements) were more satisfied with both their bodies and apparel fit than women with larger bodies. Similarly, Pisut and Connell (2007) found high correlations between level of satisfaction (cathexis) and the size of the waist and hip (circumferences/measurements). They found that larger hip or thigh and waist measurements had a negative effect on an individual's self-perceived physical attractiveness as well as cathexis (Petrie *et al.*, 2002). The same study (Pisut & Connell, 2007) further revealed that 70% of women's dissatisfaction with their bodies emanated from the size of their abdomen. Fan (2004:11) found a correlation between body (part) cathexis and fit perception, and also observed that women were self-conscious about the size of their lower bodies. As a result, women were generally dissatisfied with RTW apparel fit for their lower bodies, yet relatively satisfied with fit for their upper bodies (Pisut & Connell, 2007).

Women of different ethnicities are likely to have different body shapes and body shape characteristics, and are also expected to exhibit different cathexis levels (Fitzgibbon, Blackman & Avellone 2000; Padget & Biro, 2003; Lee *et al.*, 2007; Shin & Istook, 2007). This may be attributed to women comparing their bodies to culturally ideal bodies which vary from culture to culture. In their study Padget and Biro (2003) found that African-American women were more satisfied with their bodies until they were very overweight, whereas Caucasian women of smaller bodies were dissatisfied with their bodies. This is because in an African culture, the ideal body is larger than a Caucasian ideal body. As culture influences perception of body size and consequently body cathexis, women of different ethnicities show different cathexis levels. As a result, full-figured African (American) women were more satisfied with their bodies and body size than smaller Caucasian (American) women (Fitzgibbon *et al*., 2000; Padget & Biro, 2003; Lee *et al.*, 2007; Shin & Istook, 2007). Furthermore, a larger sized woman who has a positive attitude towards her body and has high self-esteem and confidence, is likely to have a higher body cathexis than a slimmer woman who has a negative attitude towards her body and low self-esteem and confidence (Manuel, Connell & Presley, 2010). Due to societal pressure created by Western societies' emphasis on the ultra-thin ideal body, more consumers of average weight are becoming dissatisfied with their bodies. Various studies (Alexander *et al*., 2005; Song & Ashdown, 2012) show that an individual's age also influences her body cathexis, as older women are more dissatisfied with their bodies than younger women.

Several studies indicate a relationship between body cathexis and apparel fit preference (LaBat & DeLong, 1990; Petrie *et al*., 2002; Robinson, 2003; Fan, 2004:11). Rudd and Lennon (2000) confirmed that women use apparel to manage their appearances and to improve their body and body parts cathexis. It is therefore imperative to investigate body parts cathexis of African and Caucasian women of different body shapes.

1.2.5 Body shape and apparel fit preferences

Alexander *et al*. (2005) recorded that individuals with different body sizes and shapes usually have different fit preferences. The main body shapes adopted in this study, namely hourglass, triangle, inverted triangle, rectangle and apple body shapes, are named according to their different body shape characteristics. These body shape characteristics are likely to influence apparel fit preference at the different body parts. Fit preference is a subjective concept as one consumer determines how she wants a particular garment (style) to conform to the shape of her body. Two consumers with the same body measurements, height, size and body shape characteristics may vary in their fit preferences. Fit preference may vary from one garment style to the next, i.e. a consumer may prefer a certain fit in one garment style and a totally different fit for another style (Manuel *et al*., 2010). Factors that influence fit preference include: personal preference, fashion trend, cultural influences (ethnicity), age, lifestyle and body cathexis (Brown, 1992:261). According to Pisut and Connell (2007), researchers have studied consumer satisfaction and dissatisfaction with fit; however, there has not been much research conducted into the relationship between consumer's RTW apparel fit preferences and body shape, which the current study seeks to investigate.

Ashdown (1998) recommends that consumers' apparel fit preferences be taken into consideration during apparel manufacturing to enhance consumer fit satisfaction. She further suggests that body shape analysis and classification by itself cannot guarantee the production of better-fitting apparel, as apparel fit is subjective. Apparel manufacturers therefore need to understand and be cognisant of consumer fit preferences in order to provide them with garments that fit satisfactorily (LaBat & DeLong, 1990; Ashdown, 1998; Le Pechoux & Gosh, 2002:6). Shin (2013:110) also observes that women of different ethnicities expressed different fit preferences. Body cathexis also influences RTW apparel fit preference. This was revealed by LaBat and DeLong (1990), Robinson (2003) and Fan (2004:11), all of whom concurred that individuals who were dissatisfied with their bodies were likely to choose loosely fitted garments to conceal the parts they were dissatisfied with. Yet, those that were satisfied with their bodies usually chose closely fitted apparel to emphasise those body parts. This study therefore also investigates young Generation Y South African women's fit preferences at selected body parts as age is one of the factors that influence consumers' apparel fit preferences .

1.2.6 The Generation Y apparel consumers

This study is targeting young female apparel consumers aged between 18 and 25 years who belong to the Echo Boom or Generation Y group. The Generation Y consists of individuals born between 1981 and 1995. The age bracket 18 to 25 years is also referred to as emerging adulthood or young mature women with fully developed bodies, and is characterised by identity exploration, high levels of personal freedom, and low levels of social responsibility (Workman & Stulak, 2006). The Generation Y is a diverse consumer group that seeks fashionable apparel that is flattering to them and whose computer and entertainment orientation influences their apparel shopping behaviour (Keiser & Garner, 2003:39; Frings, 2005:34). To reach this consumer segment, the fashion industry advertises on television shows, movies, websites and magazines. This consumer segment generally purchases apparel for various reasons that include being attractive and fashionable, showing off their physical attributes, to satisfy their emotional needs and to impress and be accepted by peers (Keiser & Garner, 2003:40; Frings, 2005:34; Oliver, 2007). The young South African women apparel consumers are no exception, as they also have a passion for fashionable clothes.

According to Keiser and Garner (2003:40) and Frings (2005:34), fashionable clothes help to boost the Generation Y consumer's confidence. This consumer segment includes individuals who are nearing the end of the adolescent stage and emerging adults who want to project and establish a certain fashion identity and may use apparel to serve as a status symbol. They may also dress to identify with a certain lifestyle similar to their peers and celebrity role models.

The shopping behaviour of multi-cultural consumer societies like the South African society is a complex phenomenon (Du Preez & Visser, 2003; Marshall *et al.*, 2004:6; Frings, 2005:34). For the reason that the South African consumer community has undergone a number of important socio-economic changes since 1994, women are more educated and are becoming a more lucrative apparel market segment. Du Preez and Visser (2003) also concur that a multi-cultural study such as the current one may reveal interesting findings on how body measurements, body shapes, perceived apparel fit problems, body part cathexis and RTW apparel fit preferences of African and Caucasian ethnic groups compare.

1.3 PROBLEM STATEMENT

According to Ashdown (1998) and Bye, LaBat & DeLong (2006), the starting point in the manufacturing of better-fitting RTW apparel is an up-to-date anthropometric database obtained by using accurate and reliable methods, and thereafter, the classification of populations into the different body size categories that are representative of the entire population. In South Africa there is no anthropometric data and body shape classes of the South African population on which RTW apparel manufacturing could be based. Literature (Bye *et al.*, 2006:66; Petrova, 2007:56-7) records that consumer populations consist of varied body shapes and sizes which, when disregarded by the apparel industry, may negatively impact on RTW apparel fit (Ashdown, 2007:xvii).

The sizing system used by the South African apparel industry was adapted from an old British sizing system (Strydom & de Klerk, 2006; Zwane & Magagula, 2006). It is not only foreign to South Africa, but is also based on out dated and inaccurate anthropometric data. Therefore, to improve apparel fit, body measurements and body shapes prevalent within the South African female consumer population must be identified and considered in the formulation of consumer-specific sizing systems (Devarajan & Istook, 2004; Bye *et al.*, 2006; Petrova, 2007:57; Park, Nam, Choi, Lee & Lee, 2009). Moreover, there is not much research evidence available in South Africa on apparel fit problems. The present study may offer the South African apparel industry a basis for designing apparel for consumers of different body shapes according to their fit needs and consequently improve consumer fit satisfaction.

The South African industry like a majority of apparel industries worldwide still does not cater for figure shape variations (Strydom & de Klerk, 2006; Shin & Istook, 2007). Furthermore, in most cases the standard body measurements used in some sizing systems are not representative of the companies' target markets (Glock & Kunz, 1995:166). Moreover, the standard figure varies from one apparel manufacturer to the next (Devarajan & Istook, 2004), which compounds the issue of apparel fit problems and fit dissatisfaction among South African consumers. RTW apparel manufacturers therefore need to understand body shape differences within populations in order to produce apparel with satisfactory fit.

RTW apparel fit problems are further compounded if the target population consists of diverse ethnic groups, like the South African population does. In many Western countries, variations in female apparel consumers' body shapes are to a large extent attributed to the diverse ethnic groups (Simmons *et al*., 2004a; 2004b; Lee *et al*., 2007; Shin & Istook, 2007; Mastamet-Mason, 2008:151; Mabuza, 2012:103). The same studies emphasised the need to study the body shapes and proportions of different ethnic groups as a way to increase consumer fit satisfaction with standardised apparel across the diverse ethnic groups. Moreover, Du Preez and Visser (2003) note that there has not been much research on apparel consumers of different ethnic origins in South Africa. Furthermore, the findings of a study by Winks (1997) revealed that the body dimensions of Black males were generally smaller than those of Caucasian males in South Africa. In the present study the African and Caucasian ethnic groups form part of the varied South African population. The question that arises is: how do the body shapes and proportions of young African and Caucasian women differ?

Furthermore, it is imperative to investigate how female body shapes and body shape characteristics of young African and Caucasian women compare with each other and differ from the ideal figure. This could help determine whether the use of standard apparel produced from the shape and measurements of an ideal figure would give satisfactory fit for consumers of different ethnic groups. Otherwise, the RTW apparel fit problems currently experienced from standardised apparel will persist.

The literature (Feather, Herr & Ford, 1996; Alexander *et al*., 2005; Manuel *et al*., 2010) further indicates that an individual's body shape and body shape characteristics influence body cathexis. On the other hand, LaBat and DeLong (1990), Petrie *et al*. (2002) and Robinson (2003) revealed a relationship between consumers' body part cathexis and apparel fit. Ethnic identity and cultural standards may also influence one's body cathexis. Different cultures have their own set of bodily ideals; members differ in how they perceive their bodies, which ultimately influences cathexis. Therefore, a question that arises then is: what is the body parts cathexis of African and Caucasian women of different body shapes?

The literature further indicates that body size and shape influence one's RTW apparel fit preferences (Manuel *et al*., 2010). Plutt (2011:35) suggests that apparel consumers of different ethnicity are likely to have different RTW apparel fit preferences. According to Pisut and Connell (2007), Western researchers have studied consumers' satisfaction and dissatisfaction with fit. However, not much research has been conducted (especially in Africa) on fit preferences of different body shapes and ethnicities. The present study will provide evidence on fit preferences of young African and Caucasian women of different body shapes and ethnicity. When taken into consideration during apparel designing and manufacturing, fit satisfaction of this consumer segment may be improved. Exploring the factors influencing apparel fit, namely: body shapes, body cathexis and fit preferences as identified in the literature, may help create a better understanding of garment fit problems among South African female consumers. Furthermore, an understanding of how these factors impact on apparel fit may also create consumer awareness and be beneficial during apparel selection.

1.4 PRIMARY OBJECTIVES AND SUB-OBJECTIVES

Primary objective 1: To identify and compare the body shapes of young African and Caucasian women

> **Sub-objective 1.1:** To identify, categorise and compare the body shapes prevalent among African and Caucasian women using measurements and three-dimensional scan images
>
> **Sub-objective 1.2:** To determine and describe the association between body shapes and ethnicity

Primary objective 2: To describe and compare visual scan images, selected body measurements and measurement ratios of young African and Caucasian women

> **Sub-objective 2.1:** To determine and describe significant differences in selected body measurements and measurement ratios of predominant African and Caucasian body shapes

Primary objective 3: To determine and describe perceived ready-to-wear apparel fit problems encountered by predominant African and Caucasian body shapes on selected body parts

Primary objective 4: To determine and describe body part cathexis of young African and Caucasian women

Primary objective 5: To determine and describe young African and Caucasian women's perceived ideal figure

Primary objective 6: To determine and describe ready-to-wear apparel fit preferences of young African and Caucasian women

1.5 SIGNIFICANCE OF THE STUDY

1.5.1 Significance for apparel manufacturers and retailers

Consumers are struggling to find well-fitting RTW apparel in the market. Manufacturers and retailers incur costs due to frequent returns of ill-fitting garments and price mark-downs of garments damaged by customers frequently trying them on. This study gives insights and understanding of body measurements, body shapes, apparel fit problems, body cathexis and fit preferences of young African and Caucasian women. Furthermore, this information may form part of a database and may be a starting point for the South African sizing survey and a foundation for designing and production of better-fitting RTW apparel for this consumer segment.

This study aimed at analysing, classifying and comparing body measurements, measurement ratios and body shapes of young African and Caucasian RTW apparel consumers. An understanding of how body measurements and measurement ratios of African and Caucasian body shapes compare may contribute to improving RTW apparel fit.

The apparel industry uses body dimensions of an ideal figure to develop and design new patterns and RTW apparel, and to produce body forms for garment fit tests, yet within any population only a few consumers conform to the ideal body. This study provides information on the body shapes prevalent among young African and Caucasian women in South Africa. Such data may give an understanding of how the young African and Caucasian women's figure shapes differ from the ideal figure. This will therefore offer a vast knowledge base that could be incorporated into the much anticipated South African sizing system. Body shape classes identified in this study may form a base for the production of RTW apparel that would provide the young African and Caucasian women with better fitting apparel. Furthermore, this study could contribute towards the production of apparel with minimal fit problems for African and Caucasian ethnic groups, thus enhancing RTW apparel fit satisfaction for these consumer segments.

The investigation of the RTW apparel fit problems experienced by different African and Caucasian body shapes gives an understanding of the specific body parts where each of the predominant African and Caucasian body shapes experience fit problems. Furthermore, fit problems associated with predominant African and Caucasian body shapes are identified. An understanding of body cathexis of the different body shapes and how it impacts on RTW apparel fit needs of young African and Caucasian body shapes may place manufacturers in a better position to know which apparel styles to produce. Once all the information above is taken into consideration during apparel designing and manufacturing, improved apparel fit may result and may subsequently lead to consumer loyalty, repeat purchases and increased revenue for both manufacturers and retailers.

1.5.2 Contribution to the existing knowledge base

There have been several studies conducted abroad on body shapes, body cathexis, fit problems and fit preferences of different consumer groups, however, Not many such studies have been conducted in South Africa. There has not been any study that has collected body measurements and identified a scientific method of classifying body shapes of South African women. Furthermore, the South African industry is in need of a sizing system that is based on body measurements, measurement ratios and body shapes of the ethnically diverse population. The apparel industry's stakeholders, i.e. RTW apparel manufacturers, retailers, consumers and apparel researchers, may benefit from this study. Information on body measurements, measurements ratios, body shapes and body cathexis impact on RTW apparel fit, and would therefore contribute to the South African sizing theory. Although most of the concepts investigated in this study are phenomena that have been studied abroad, they still need to be explored in a Southern African context. The findings of this study could therefore form a research base to benefit the South African apparel research and manufacturing sector.

1.6 OUTLINE OF THE STUDY

This thesis consists of six chapters:

Chapter 1: The study in perspective

This chapter presents the background information and introduces key concepts that form the basis for this study, namely measuring the body, body shape classification and body shape categories, perceived RTW apparel fit problems and their sources, ethnicity, body cathexis and fit preference. Other components of this chapter include objectives, problem statement, significance and an outline of the study.

Chapter 2: Theoretical framework

This chapter enumerates and discusses the literature review based on the theoretical framework of the study, the Ashdown's model. The four main concepts of this model are discussed in detail as the key elements of a sizing system. Components of the model relevant to this study are also highlighted and discussed in detail in this chapter, namely population measures, 3-D body scanning, fit issues/fit quality management, subject opinions on fit perceptions (fit problems), as well as communication of sizing and fit between consumers and manufacturers.

Chapter 3: Supporting literature review

This chapter outlines an in-depth review of literature on the sizing and fit phenomena. The literature covered includes the concepts: Methods of measuring the body, Body shapes classification and categories, RTW apparel fit problems and their sources, body cathexis and apparel fit preferences, the ideal figure, and apparel styles and designs suitable for the different figure shapes.

Chapter 4: Research methodology

This chapter is a detailed account of the procedures followed when conducting this research. These include the research strategy employed, data collection methods and instruments used, and the measures taken to ensure reliability and validity of the instruments and subsequently valid results, as well as how research ethics were observed. It also presents the methods used to analyse data.

Chapter 5: Results, discussions and interpretation

The results of this research are presented, interpreted and discussed according to the objectives of the study as well as the data collection methods used, namely scan data (i.e. body measurements and scan images), Body Shape Assessment Scales, and questionnaire data.

Chapter 6: Conclusions, limitations of the study, contributions to theory and recommendations for future research

This chapter gives an account of conclusions drawn from the findings of this study, evaluations of how the quality of the study was achieved, limitations of the study, recommendations emanating from the findings of the study, and suggestions for further research.

The thesis is written in British English and the Harvard method of referencing is followed.

CHAPTER 2: THEORETICAL FRAMEWORK

2.1 INTRODUCTION

Ready-to-wear (RTW) apparel refers to clothes that are completely made in factories, produced in advance and are ready to be worn. To produce RTW apparel, manufacturers use a set of standard sizes or sizing systems that are based on the body measurements of a selected standard or ideal figure. Apparel sizes for the entire target population are adapted from the standard figure through the grading system (Burns & Bryant, 1997:102; Stone, 1999:179; Brown & Rice, 2001:1). The main aim of RTW apparel is to provide reasonable fit to apparel consumers of different body shapes and sizes (Winks, 1997). According to Ashdown (1998) and Bye *et al*. (2006), the starting point in the manufacturing of well-fitting RTW apparel must be an up-to-date anthropometric database that is representative of the entire population, and obtained using reliable methods. Thereafter, the anthropometric data needs to be classified into the different body shape categories prevalent within that population. Literature records that consumer populations consist of varied body shapes and sizes, which impact on RTW apparel fit. Therefore classifying a population into different body shape categories enables apparel manufacturers to provide better-fitting apparel for each body shape category (Ashdown, 2007: xvii).

2.2 CONCEPTUAL FRAMEWORK

Ashdown's model on effective sizing systems is adopted as the conceptual framework of the present study. Ashdown (2000) sees sizing systems as the focus around which all factors concerning sizing and fit evolve. Ashdown's model (**Figure 2.1**) identifies the main factors affecting sizing systems and consequently the fit of RTW apparel to be the population measures (body measurements of a population), design features (construction of apparel), the fit issues (fit quality management), and the communication of sizing and fit between manufacture and consumer through size labelling and consumer's post-purchase reaction. For purposes of this study, the focus will be only on the highlighted components of

Ashdown's model that are applicable to this study (**Figure 2.1**). These are the population measures (Methods of measuring the body) (highlighted and marked A), fit issues (marked B), and communication of sizing and fit between consumers and manufacturers (marked C).

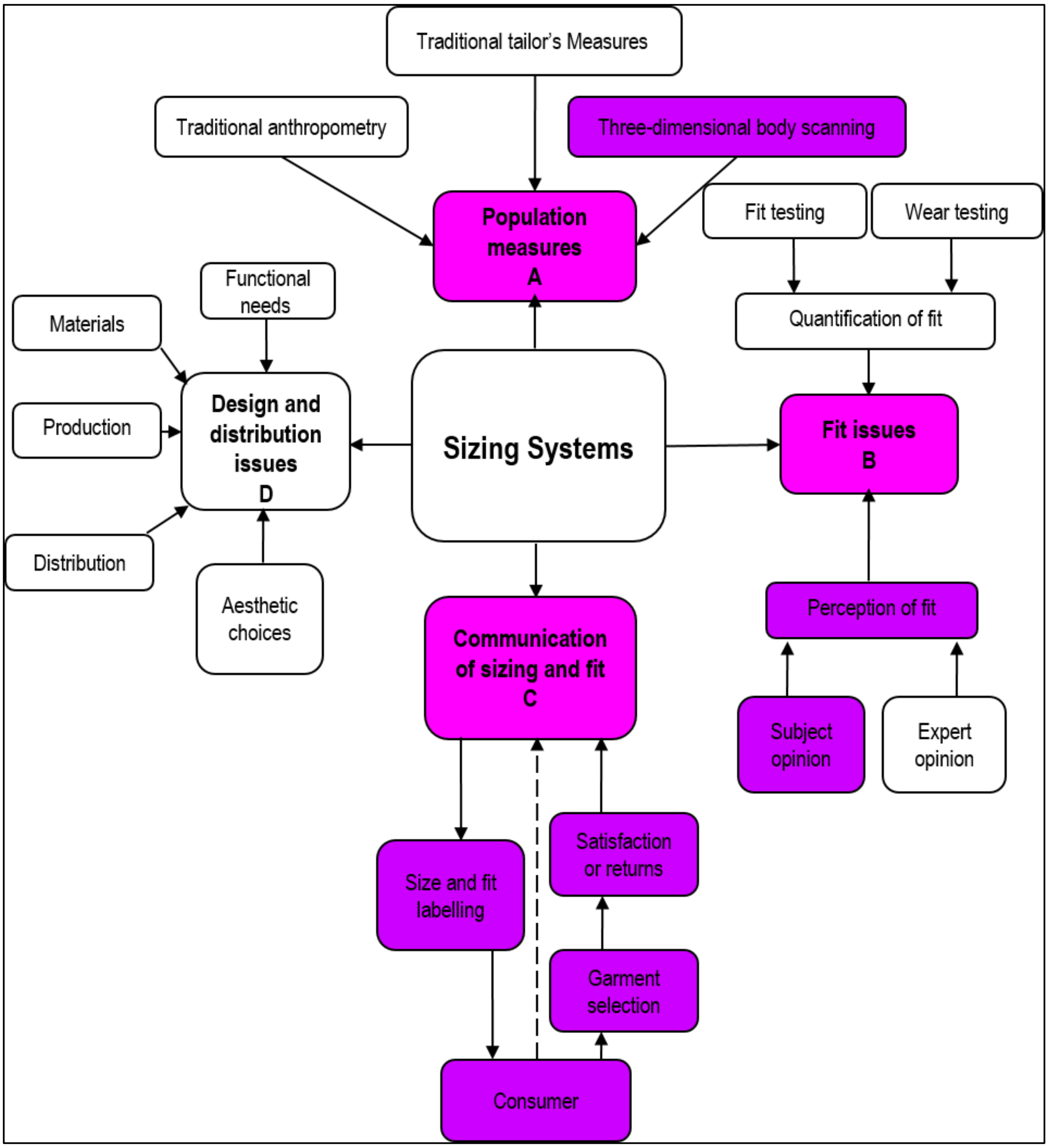


FIGURE 2.1: THEORETICAL FRAMEWORK (Source: Ashdown, 2007:xix)

Even though the other components, i.e. design features (apparel construction) and distribution, are not the main focus of the present study, it should be noted that it is also important to base apparel designs and distribution on accurate body measurements and body shape classes of a target market. If manufacturers can base all the main components of Ashdown's sizing system model on body shape characteristics of their target market, RTW apparel fit problems would be minimised and subsequently consumer fit satisfaction may be maximised. In addition to the highlighted components (**Figure 2.1**), the present study also discusses consumers' body shapes, apparel fit preferences and body cathexis as other factors influencing consumer fit perceptions.

2.3 THE SIZING SYSTEM

A sizing system is defined as a chart of body dimensions created by dividing the target market into different body shape categories based on similar key dimensions such as height or circumferential ratios between key measurements (Winks, 1997; Keiser & Garner, 2003:301; Petrova, 2007:57). It is a method used to create apparel that would fit a target population of different sizes (Branson & Nam, 2007:264). According to Glock and Kunz (1995:157), most often manufacturers either copy already existing size charts from other companies or base new ones on consumer records whose measurements may not necessarily be the same as those of the target population. New sizing systems may also be created or adjusted by trial and error relying on the analysis of feedback of smaller consumer surveys and also from returned merchandise reports (Petrova, 2007:57). A sizing system consists of sizes that are evenly distributed from the smallest to the largest. It aims at providing RTW apparel that fits most consumers within a population (Ashdown, 1998; Pisut & Connell, 2007). Apparel firms identify and base their sizing systems on a standard figure, the measurements of which are proportionately graded into sets of larger and smaller sizes. However, in most cases the standard body measurements are not representative of the measurements of the companies' target market (Glock & Kunz, 1995:166). Moreover, the standard figures vary from one apparel manufacturer to the next (Devarajan & Istook, 2004) and they also change from time to time, which results in inconsistent fit and consequently ill-fitting apparel and fit dissatisfaction among consumers.

The term *grading* refers to the increasing and decreasing of a base pattern to produce apparel of various sizes (Schofield, 2007:152). This process involves scaling up for larger sizes and scaling down for smaller sizes, following grade rules adopted for that particular sizing system. Grade rules are the amount of allowance added or subtracted from each measurement as it changes from one size to the next (Keiser & Garner, 2003:318). Apparel grading results in apparel that is similar in shape as the body shape used to come up with the base pattern, which in most cases is the ideal figure shape. The graded apparel usually results in poor fit for consumers with different body shapes from the ideal figure. Therefore in order to give better fit, the grading and pattern making techniques should be developed from body measurements and shapes of the target population (Workman, 1991; Glock & Kunz, 1995:167, 108; Keiser & Garner, 2003:251), which is currently not the case in most apparel manufacturers.

South African female apparel consumers vary in body size and shape. Therefore, apparel grading by manufacturers need to originate from similar body shapes as those prevalent in the population, if reasonable fit is to be achieved. The diverse ethnic groups in South Africa partly contribute to the different body shapes and sizes. As a result, the South African apparel industry needs a South African sizing system that will take into account the diverse body shapes and sizes and provide better fit for the consumers. This may require representative size charts to facilitate development of base patterns that are representative of most prevalent body shapes among the diverse ethnic groups, which when graded will result in better fitting apparel for a majority of consumers. This study will, among other things, compare body shapes, body shape characteristics and measurements of young African and Caucasian women.

Petrova (2007:81) suggests that best apparel fit can be achieved if the population is divided into a lot of categories or sizes i.e. customised size charts, to give better fit to a number of individuals with similar body measurements. This is unlike the sizing method used for loose fitting clothes that aims to accommodate many individuals within one apparel size. Furthermore, the apparel is sized into small, medium and large, and many individuals will wear one size without a definite fit. As suggested above, a number of researchers state that an effective sizing system should aim at providing an optimum number of size groups. These may accommodate as many body shapes and sizes as prevalent in the population and also provide well-fitted garments at a lower cost (Winks, 1997; Petrova, 2007:59, 67).

Beazley (1998) suggested that a sizing system should be simple and consistent so that potential consumers can recognise a size that would give them reasonable fit. The size range within a sizing system should aim to be both convenient for production and should also satisfy consumers’ fit requirements. Strydom and de Klerk (2006) and Zwane and Magagula (2006) recorded that sizing systems used by the Southern Africa apparel industry have been adapted from an old British sizing system. Since South Africans are not the same size as Britons, the patterns had to be graded. However, the resulting apparel was ill-fitting because the initial basic blocks were not based on the body measurements and shapes of South African consumers. This study therefore emphasises that any sizing system should be based on the body measurements of the target market, for example, a sizing system used in the production of apparel for the young African and Caucasian consumer segment must be based on their body measurements and predominant body shapes in order to result in better fitting apparel. Moreover, according to Shin and Istook (2007), consumers in an ethnically diverse population have different body proportions and body shapes and consequently different apparel fit needs.

Sizing systems of several countries are based on definitions of figure shapes, description of garment sizes, key dimensions used and garment types. Some sizing systems have similarities in the way they classify women's figure shapes, select key dimensions and label garment sizes. Key and secondary dimensions are added to come up with body dimensions used in pattern development (Petrova, 2007:66). Key dimensions are commonly used to classify populations into different body shapes. However, according to Strydom and de Klerk (2006), South African manufacturers do not specify the body shapes their apparel is meant to fit. They produce apparel based on standard figures that cater only for consumers with similar body shapes as the standard figures. Furthermore, the average figures differ from one manufacturing company to another, and result in inconsistent garment sizes and fit. This is evident in retail outlets where apparel with similar dimensions is sized differently due to vanity sizing, which further compounds apparel fit problems. Vanity sizing is the practice of apparel companies to manipulate garment labels to reflect smaller sizes. The garments are cut larger to appeal to the vanity of consumers who like to think of themselves as smaller (Kemp-Gatterson & Stewart, 2009:254).

The selected key dimensions on size labels should indicate the body shapes of the individual for whom the garment is made. The number and type of key dimensions selected are also dependent on the style and intended fit of the garment. Petrova (2007:66) recommends that size labels should reflect bust, hip, and height dimensions for upper or whole body garments. However, some systems use bust circumference for most upper and whole body garments, and the hip and waist circumferences and height for lower body garments. Petrova (2007:66) further recommends that apparel size labels should show key dimensions and must always include the absolute value of the largest body measurement in order to be representative of the basic body shape. However, if apparel consumers are to benefit from such apparel size labels, they must know their key body measurements, which is seldom the case.

2.3.1 Population measures used in the clothing industry

Ashdown's framework (Ashdown, 2007:xix) in **Figure 2.1** presents the starting point of an effective sizing system as obtaining the target populations' measurements (highlighted and marked A). The different methods used to obtain body dimensions of a population are: traditional tailor's measures, traditional anthropometry and three-dimensional body scanning (Ashdown, 2007:xvii). The accuracy and reliability of body measurements collected depend on the precision of the method selected, the equipment used, as well as the expertise of the measurer (Ashdown, 2000; Simmons & Istook, 2003). For an effective sizing system, the population measurements need to be current, accurate and consistent, so that when body dimensions are converted into patterns, well-fitting apparel could be produced. Failure by the apparel industry to identify and use the best method of measuring the body may result in persistent apparel fit problems (Winks, 1997). Currently, among the three different methods of population measures, the most reliable and accurate method is the three-dimensional body scanning (highlighted in **Figure 2.1**), which is the method that was employed in this study. The NX-12 3-D body scanner created three-dimensional, accurate virtual images of the participants' bodies, from which measurements were extracted. It has software that allows automatic extraction of anthropometric data loads and saves the data files in seconds, which is an advantage when measuring and extracting measurements of a large number of subjects (McKinnon & Istook, 2001). While there are numerous other uses of the 3-D body scanner, the present study only extracted selected measurements and generated the 3-D virtual image, showing front and side views of participants' bodies.

The point of departure and integral part of all components of Ashdown's model is accurately capturing body measurements, using reliable methods and the classification of the target market into different body shape categories. Failure by the apparel industry to identify and use the best method of measuring the body may result in persistent apparel fit problems (Winks, 1997). An understanding of predominant body shapes within populations would enable apparel manufacturers to provide better-fitting apparel for each body shape category (Ashdown, 2007: xvii). The key body measurements and virtual scan images captured in the present study were used to classify young African and Caucasian women into predetermined body shape classes identified from literature. The three different methods of population measures are discussed next; the three-dimensional body scanning is discussed in detail as the method that was employed in the present study.

2.3.2 Traditional tailor's measurements

Traditional tailor's measurement is the method of taking body dimensions manually, using a measuring tape (Schofield, 2007:152). This method is performed differently by different tailors who follow different measurement procedures and have varying levels of expertise, which in itself could be the source of fit problems. Taking body measurements is guided by landmarks which even if they are not marked, give an idea of where the body should be measured. However, landmarking the body before taking measurements is not usually done in traditional tailor's measures. Body dimensions taken are pre-determined based on the type of garment to be made (Cornell University, 2003). It is a common practice for most tailors to take measurements on body contours while the subject is fully clothed. The one commonly followed guideline is running the index finger between the tape measure and the body to ensure that the tape measure is neither too tight nor too loose. This guideline may vary from one measurer to the next. These, together with subjects' posture shift, are likely to yield erroneous measurements, which may consequently contribute to the production of ill-fitting apparel (Ashdown, 2000; Yu, 2004:173; Strydom & de Klerk, 2006). It is therefore recommended that the measurement techniques must be standardised to minimise errors and discrepancies and subsequently apparel fit problems.

2.3.3 Anthropometric measurements

Anthropometry is the science of measuring physical characteristics of human beings in order to determine their proportions, shapes and sizes. The term anthropometry originates from Greek words, 'anthropo' and 'metreein' which respectively mean 'human' and 'to measure'. Applied anthropometrics entail numerical data pertaining to the size, shape and other physical characteristics of human beings (Yu, 2004:171; Wang, Wu, Lin, Yang & Lu, 2006). Methods and tools used in anthropometry have been developed to give valid and reliable measurements. They are an improvement on the traditional tailor's measurements that were subject to errors (Simmons & Istook, 2003). Anthropometric tools and methods include linear methods where callipers and calibrated measuring tapes are used (Bye *et al*., 2006). Anthropometry is a complex, time consuming and expensive process that requires skilled personnel in order to obtain valid and reliable data. Like the traditional tailor's measurement method, the accuracy of anthropometry depends on the expertise of the measurer. It is therefore recommended that more than one measurer be engaged to minimise error. Other sources of error common in anthropometry include: inaccurate location of landmarks, subject positioning, instrument application, and amount of pressure applied during measuring (Simmons & Istook, 2003).To ensure consistency and accuracy of measurements, it is important that landmarks are accurately located and personnel are well trained for consistent and accurate measurements.

Anthropometry requires subjects to wear minimal clothing in the form of leotards or underwear. Therefore, a changing facility must be accessible to subjects that need to change into leotards or remove upper garments (Beazley, 1996). The measurer and the subject are in contact during the landmarking and the actual measurement procedure (Apeagyei *et al*., 2007). This then makes anthropometry an intrusive method of body measurement. Landmarks are the anatomical guide points or sites on the body that serve as end points for measurements and anchor points for placement tools (Fan, 2004:35-35). Landmarks include bony protrusions under the soft flesh or joints where bones are hinged together. They are located by touching the body to feel them (Yu, 2004:169; Bye *et al*., 2006; Schofield, 2007:152). Landmark identification and placement of a tape measure differs from one measurer to the next. As a result it is not always possible to repeat and reproduce measurements. The measurer, prior to taking body measurements, needs to determine the dimensions to be taken, acquire and arrange the measuring tools in advance to prevent wasting of time and to also reduce contact time with the subject (Beazley, 1997; Winks, 1997; Simmons & Istook, 2003; Ashdown & Dune, 2006).

Newer and improved methods of measuring the human body were later introduced as an improvement on previous methods. The introduction of the three-dimensional body scanner came through efforts by researchers to come up with quick and more reliable measurements of the three-dimensional profile of the body with some degree of accuracy and also as a means to address the apparel industry's need to produce well-fitting apparel for consumers (Yu, 2004:135).

2.3.4 Three-dimensional body scanning

A body scanner is an instrument designed to create a three-dimensionally accurate virtual image of the body, from which measurements are extracted. According to Xu, Huang, Yu and Chen (2002b) and Istook and Hwang (2001), unlike the early scanners that were the size of an average living room, the new scanners consist of one cubicle or booth that is about 2.5 m tall and 1.5 m wide, one or more light sources, one or more capturing devices, software, computer systems and monitor or screen to visualise the data capturing process. The different types of body scanners include laser, infrared, structured white light, microwave and photogrammetry (Simmons & Istook, 2003). Three-dimensional body scanners that utilise white light are considered the safest among the different body scanners (Rosenau & Wilson, 2001:409; Petrova & Ashdown, 2008). Scanners vary in accuracy, cost, measurement extraction ability and size. The present study utilised the $[TC]^2$ NX-12 Version 7.2 3-D body scanner, it is worth noting that newer models of 3-D body scanners like the human solution may be more accurate.

2.3.4.1 The scanning procedure

A laser, white or any other source of light illuminates the object being scanned, in this case the human body (Rosenau & Wilson, 2001:409; Xu *et al*., 2002b; Istook & Hwang, 2001; Petrova & Ashdown, 2008). A series of cameras or sensors capture the light reflected by the object being scanned, and the computer system generates either specific body measurements or the three-dimensional digital image of the body. The technician or operator gives instructions on the scanning procedure to the subject through audio streams; the scanner also has an option of being operated by the subject. The scanner is connected to a control box where all the scanning and measuring commands sent from the PC are controlled. It is where the projectors are turned on and the cameras are activated to capture images (Xu *et al*., 2002b). The ultimate goal of using 3-D scanning in the apparel industry is to provide affordable and better-fitted clothing in the shortest possible amount of time (Petrova & Ashdown, 2008).

The NX-12 3-D body scanner comes with software that has automatic noise elimination, data filtering, data smoothing, hole filling and data compression, which create a high-fidelity, segmented 3-D model of the human subject. Noise elimination and data filtering removes any stray points, and data smoothing removes low level noise in the scan image. Hole filling closes any gaps in the scan image, compression is used to achieve a very light yet defining data set, and segmentation is the ability to separate the body image into individual limbs (Bougourd, 2004). Body scanning has software that allows automatic extraction of anthropometric data in seconds, and loading and saving of the data files, which is useful when measuring a large number of locations on the human body (McKinnon & Istook, 2001). Body scanning defines and gives multiple options of the same measurements using different specifications, body width and depth measurements from back to front and can also customise standard measurements to specifications. It also gives extra measurements that become useful when automated landmarks are shifted, identifies body joints, and can also combine measurements using a measurement calculator. Saved scanned data (measurements and images) can be accessed any time.

2.3.4.2 Applications of the 3-D body scanning

The adoption of 3-D body scanning by the apparel industry is likely to benefit the manufacturers, retailers and consumers. The ability of 3-D body scanners to capture and save consumers' virtual images makes apparel fit analysis possible, for example, the internet "virtual try-ons". During virtual try-ons the body scanners predict consumers' body measurements and body shapes and enable consumers to try on clothing digitally in the correct apparel style and colour combinations on 3-D body scan images that simulate the consumer's body shape and to also assess apparel fit and style suitability remotely (Yu, 2004:153). The "virtual try-ons" encourage consumers to buy related and complete items as well as accessories thus contributing towards solving fit problems, and when used for automated fit, they produce better-fitting apparel for the consumer. Three-dimensional scanners also allow for improved customer service in the form of product visualisation and fashion style and size advice (Yu, 2004:153). When consumers make purchases, their decisions are usually informed and refined to such a degree that apparel returns due to size-related problems are minimised or completely eliminated (Bougourd, 2004). This increases revenue thus benefiting manufacturers and retailers. On the other hand, the use of 3-D body scanners in retail outlets make consumers' shopping experience more enjoyable and satisfying as consumers get better-fitting apparel and eliminate the inconvenience of returning ill-fitting garments and save time due to improved in-store customer service. The 3-D scanning has also made shopping for other family members to be done with some degree of confidence as RTW apparel produced with the help of 3-D scanning resemble made-to-measure apparel that is obtained at a reasonable price (Bougourd, 2004).

Body scanning has a number of other useful applications for the apparel industry. These include attracting and convincing customers to make purchase decisions in retail outlets, to create garments suitable for different three-dimensional human body shapes using personalised apparel designs in digital format, which include making pattern blocks with 3-D grading and for viewing the simulated garment on a model to evaluate fit, and also for a digital tailor and a virtual mock and fashion show (Yu, 2004:145; Yu, 2009). The body scanning technology can also be used in size surveys, development of size charts, to scan live models and to create apparel fit database and standards (Bougourd, 2007:122).

Ashdown *et al*. (2004) pointed out that body scanning provides multi-dimensional data that has the potential to provide new insights into sizing and grading systems. According to Bye *et al*. (2006) and Petrova and Ashdown (2008), 3-D body scanning provides anthropometric data that can be used in the development of effective sizing systems for apparel products. The 3-D body scanning can also be used for pattern generation to produce customised apparel by transferring body shapes and measurements to Computer-Aided Design (CAD) systems accurately (Yu, 2004:135-36).

Consumers may also use 3-D body scanning to compare garment measurements with their body measurements, analyse apparel fit by evaluating clothing appearance such as drape, wrinkling, and bagging (Fan, 2004:31), and select their correct apparel sizes (Petrova & Ashdown, 2008). Additionally, in developed countries, consumers may have their scan information stored in smart-cards. These cards could be used in in-store kiosks to match a catalogue of ready-made styles with the consumer's exact body shape ($[TC]^2$, 2005). This may also help show how the consumers will look in certain apparel styles. These cards could also help consumers to find RTW apparel that gives them a similar fit as custom-made apparel ($[TC]^2$, 2005). Three-dimensional body scanning also enables the formation of garments by digitally draping fabric onto 3-D body scan models and by adding seam ease and fabric give.

Furthermore, 3-D body scanners also map the body ([TC]^2, 2005). This contributes towards addressing apparel fit challenges of providing satisfactory fit to people with similar measurements but different proportions (Bye *et al*., 2006). These challenges are not adequately addressed by the traditional methods of body measurement. 3-D body scanning can also be used in the communication of sizing and fit in the apparel industry (Istook & Hwang, 2001; Devarajan & Istook, 2004; Locker *et al*., 2005).

The 3-D body scanning software can be programmed to classify the population into different body shapes. This is an added advantage over other methods of classifying figure shapes, as the optical image of the body can be rotated on the screen enabling it to be examined visually from different angles. It is also a more reliable and effective method for analysing and classifying the body. These and many more 3-D body scanner applications are widely used in developed countries as the 3-D scanning technology is not readily available in the Southern African region due to the prohibitively high costs. Nonetheless this study was able to utilise one belonging to the Council for Scientific and Industrial Research (CSIR): Materials Science and Manufacturing Unit. The scanner was available to the researcher for one month, as a result its use was limited only to scan participants' virtual images from which selected body measurements were extracted.

2.3.4.3 Challenges of 3-D body scanning

Even though 3-D body scanning has so many advantages compared to the traditional methods of body measurements, it is worth mentioning that some scanners still need to overcome a few challenges. For example, some still require manual landmarking before scanning, which is not only time consuming, but also thwarts the benefit of three-dimensional body scanners of being quick, accurate, efficient and non-intrusive (Simmons & Istook, 2003). It is on this basis that Simmons and Istook (2003) suggested the need to reconcile the different systems of 3-D body scanning to come up with standardised procedures to measure the body and locate landmarks, as different systems landmark and measure the body differently (Yu, 2004:166). Furthermore, it is difficult to obtain data from hidden parts of the human body such as armpits, the crotch, and areas under the bust and chin (Zwane, Sithole and Hunter (2010). As a result these areas are often shaded and cause problems of missing data. Body parts such as shoulders and crotch also do not show very well due to their positioning (Yu, 2004:165). This study allowed two scans in the body measurement posture and also used the [TC]^2 NX-16 Version 5 Software to move data points to new locations thus eliminating the problem of missing data.

Another drawback of the three-dimensional body scanning is that, to be scanned, individuals must either strip to their underwear or wear leotards and then strike a certain pose (Rosenau & Wilson, 2001:409). This is usually not well received by some subjects, who eventually give in after some degree of persuasion. Participants in the current study utilised the enclosed dressing room adjacent to the scanning cubicle which ensured privacy. During scanning, the human body constantly changes due to movements caused by swaying, breathing and changes in posture. These changes can affect the accuracy of the measurement of the chest circumference, and as a result the quality, accuracy and integrity of the three-dimensional image may be in question (Xu *et al*., 2002b). The $[TC]^2$ NX-12 Version 7.2 3-D body scanner takes approximately 54 seconds to capture a participant's virtual images. Thereafter, the required measurements could then be extracted. According to Alexander *et al*. (2005), obtaining reliable measurements alone does not guarantee the production of well-fitting apparel; these measurements have to be translated by apparel designers, pattern makers and apparel manufacturers into apparel that conforms to the body shapes of the target consumers.

2.4 READY-TO-WEAR APPAREL DESIGN FEATURES

Once the accurate body measurements of the target market are obtained, they then form the foundation on which apparel patterns are developed. Design is defined as "the organisation of design elements using design principles to create products that are aesthetically pleasing to the observer" (Keiser & Garner, 2003:177). According to Marshall *et al*. (2004:267), fashion manufacturers use their knowledge of apparel design to provide aesthetically pleasing apparel to a population of diverse body shapes and sizes. Different body shapes require different garment styles and designs. In order to ensure good apparel fit, the body shapes of the target market must be taken into account when selecting design features. Garment designs should therefore be based on figure shapes and sizes of the target populations so that they enhance apparel fit, good looks, and maintain its characteristics over many wear and care cycles (Brown & Rice, 2001:2). Failure to do so may result in ill-fitting apparel.

2.4.1 Creation of apparel patterns

Pattern development is the first step in the development of apparel from a concept to a product. It takes into account body shape characteristics of the consumers and their fit expectations (Glock & Kunz, 2005:186; Burns & Bryant, 1997:155, 177; Keiser & Garner, 2003:250). Product developers use a pattern development method or a combination of methods appropriate for the fabric and apparel style being produced. According to Zangrillo (1990:47), women need clothes to maximise their fashion and this can be achieved if the style lines and details are in proportion to their body size and shape.

There are three methods of pattern development; these are draping and flat pattern making (Glock & Kunz, 1995:156; Keiser & Garner, 2003:250). Draping is done when patterns are developed using a cheap kind of fabric such as muslin. The fabric is draped or shaped around a three-dimensional body or dress form to create a three-dimensional fabric pattern, which is then converted to a two-dimensional paper pattern (Keiser & Garner, 2003:250). To achieve good fit from draped patterns, it is imperative that the body forms used must represent the body dimensions and body shapes of the target market. Draping requires the selection of garment fabric with good drape and hand to maximise its effectiveness in the design (Glock & Kunz, 1995:157; Keiser & Garner, 2003:250). Drape is a fabric characteristic that determines how the fabric hangs over a three-dimensional form like the human body. Alternatively, hand is the way the fabric or apparel feels against the skin. Fine fabrics give softer drape than coarse ones (Keiser & Garner, 2003:155).

Pattern drafting requires that the body measurements of the target market be obtained first and then a pattern be developed by adding style lines and ease, resulting in a two-dimensional design. The pattern can be constructed manually or by the use of a computerised pattern-drafting programme such as Gerber, Assyst and Lectra (Keiser & Garner, 2003:252). The flat pattern method is the most commonly used pattern making method in the fashion industry, and involves adding style changes on an already existing basic pattern. For example, fitting ease is added without seam allowances, or the style of the final pattern may be modified to achieve a new design. This may include the use of a sloper whose cut and fit have already been tested prior and are well received by the company's target market. The manipulation of the basic blocks can be done manually or by computer (Keiser & Garner, 2003:250). Whichever pattern making method is selected, it is important that it is based on the body measurements and body shapes of the target market for the production of better fitting apparel. Suitable apparel styles for the different body shapes are discussed further in **Chapter 3**.

Once the base pattern is developed, prototype apparel is produced and evaluated for fit (Bougourd, 2007:140). If necessary, the base pattern may be modified, approved and then graded to come up with a set of apparel patterns for the entire target population. It is important that grade rules are observed during pattern grading in order to maintain consistent fit of all the garments produced in that size range. Graded garments should fit and look like the original garment (Glock & Kunz, 1995:166). However, a number of apparel manufacturers take their base patterns from an ideal figure. But, if apparel fit is to be achieved the base patterns used need to be representative of the predominant body shapes within the target population. Therefore, manufacturers should consider rather having several base patterns to accommodate the different figure shapes prevalent in a target market.

2.4.2 Apparel functional needs

Brown (1992:2) distinguishes two aspects of apparel quality, namely physical features (i.e. what the garment is) and performance/functional features (i.e. what the garment does). Brown (1992:2) suggests that garments must be planned not only for appearance and attractive style, but also to function according to the intended end use. Functional attributes of apparel include features such as a garment's durability, utility, fit, comfort and care. Well-designed apparel must allow the wearer to put it on and be able to move comfortably in it. Utility is the usefulness of the garment and it entails fit, comfort, care, function and durability. Fit is the way apparel conforms to or differs from the body (Brown & Rice, 2001:153). Comfort is an important attribute of apparel. It is an indication of how apparel interacts with the body (Brown & Rice, 2001:198). Care has to do with the upkeep of the garment, making it suitable for continued wear. The functional purpose of a garment is its ability to perform its intended end use based on the qualities it possesses. Durability refers to the ability of a garment to retain its structure and appearance after wear and care (Glock & Kunz, 2005:136, 174; Brown & Rice, 2001:48). Therefore, when designing garments, consumers' body characteristics should be taken into account as these influence apparel fit and garment performance. Apparel that does not perform as expected may be regarded as ill-fitting. The present study also focuses on fit problems experienced by young African and Caucasian consumers with RTW apparel.

2.4.3 Apparel style choices

The aesthetic performance of a garment refers to its attractiveness. It includes the design, material and construction techniques used. The aesthetic properties of a garment refer to how the consumer's senses of touch and sight contribute to the perception of the garment. Apparel aesthetics depend on how elements and principles of design contribute to the general appearance of the garment. That is, how well apparel meets the expectations of attractiveness and if it fulfils the wearer's emotional needs. Aesthetics influence consumers' acceptance of a garment (Brown & Rice, 2001:2). The choice of fabric used influences the aesthetic performance of a garment, as the fabric design and apparel construction interacts.

Attributes of apparel attractiveness include colour, pattern, colour consistency, lustre, opacity, and hand (Brown & Rice, 2001:2).

Fabric colour is the initial attribute that captures consumers' attention. Drapability, lustre and texture are other attributes consumers consider during apparel selection, as these determine a fabric's suitability for the different apparel designs. Some designs require soft and flowy fabrics, while others need stiff and firm fabrics (Brown & Rice, 2001:2). Lustre is the reflection of light by the fabric surface, and texture refers to how smooth or rough the fabric is; the term hand refers to the way fabric feels to the skin. Therefore, the fabric and its aesthetic attributes must take into account the final apparel design, body shape and proportion of the wearer. All of these factors affect the appearance of apparel and consequently it's fit. Materials used in apparel should also be based on the design, construction, and intended appearance of the finished garment, and should enhance the garment fit. Therefore their selection should take the consumer's body shape and size into consideration.

2.4.4 Materials used in apparel manufacturing

Materials refer to the fabrics and trimmings/findings used in the manufacturing of apparel. These include interlinings, linings, trims, zippers, buttons and threads (Brown & Rice, 2001:47). The findings and trims must be appropriate for the style or design, the intended end use of the garment and also the body shape and size of the target market. Even though trims do not have a significant effect on the sizing and fit of apparel, they should be selected in such a way that they enhance the attractiveness of the garment. Their size, colour, shape, texture and application should harmonise with the garment. Material characteristics such as drape, hand and texture as they determine how the garment will hang on one's body which impact on apparel fit (Branson & Nam, 2007:271; Keiser & Garner, 2003:398).

Types of fabric include stretch and non-stretch, properties that influence the drapability, hand and texture of a fabric and subsequently how apparel will fit the body. Stretch fabrics are useful for their versatility in performance, i.e. they are comfortable, and enhance performance and fit. Fit problems may be minimised by the use of stretch fabrics (Branson & Nam, 2007:267). One size of a stretch garment has ease that allows a number of individuals of the same size yet different figure variations to be accommodated with ease. However, extra care is necessary during pattern making and garment production when using stretchy fabrics (Branson & Nam, 2007:267). Stretchy fabric may be stretched out during laying up, causing the cut panels to shrink after cutting and resulting in a smaller garment than the intended size, consequently resulting in ill-fitting apparel. Non-stretch fabrics, on the other hand, require addition of ease to achieve good fit. The use of design features that incorporate wearing ease into patterns becomes necessary when using non stretch fabrics (Hunter & Fan, 2004:97; Branson & Nam, 2007:267). After pattern making, and the selection of fabric and material, the garments are then assembled.

2.4.5 Apparel production

Even though apparel production is beyond the scope of the present study, it is discussed briefly because the sizing and fit of apparel may be compromised during clothing production, resulting in inconsistent and poor fit. The first stage of apparel manufacturing is spreading, this is laying out of multiple layers of fabric in preparation for cutting out patterns. Spreading can be done manually or mechanically (Ashdown *et al*. (2007:358). The success of cutting depends on how accurately each layer of fabric is placed on top of the previous layer (Stone, 1999:174). Multiple layers save time and reduce costs. Yet failure to monitor fabric layers during spreading may lead to slippage and cutting of uneven pieces that, when allowed to go through the assembling process, may result in inconsistent sizes and consequently ill-fitting garments (Ashdown *et al*. (2007:358). Spreading calls for fabric grain and edges to be accurately aligned in such a way that all the fabric layers have consistent tension (Ashdown *et al*. (2007:358). The way fabric is spread can affect the dimensions of the pattern pieces and ultimately the fit of the garments. Tight fabric tension during spreading may result in too small pattern pieces when tension is released, and subsequently smaller garments sizes than what they are sized to be (Ashdown *et al*. (2007:359). The opposite is also true: fabrics laid loosely, with creases and wrinkles, alter the overall shape and size of the pattern when the wrinkles and creases are smoothed out (Ashdown *et al.,* 2007:359), and larger apparel with poor fit may result, as the size of the garment will not correspond to the garment's initial dimensions specifications.

After spreading, the multiple layers are then cut, either manually or by automatic computer-guided cutting blades. Apparel sizing and fit may be compromised if pattern pieces are not cut out with precision. Cutting errors may be reduced by observing fabric shifts and the angle of cutting blades (Ashdown *et al.,* 2007:359). The method used to cut fabric may affect the appearance and quality of the garment produced, as highlighted above. Fabrics need to be marked accurately and markings must be visible throughout the production process to ensure that pieces are joined accordingly. Poorly marked pieces may lead to errors in joining, which may lead to disfigured apparel with poor fit (Ashdown *et al.,* 2007:362). After cutting, all the parts that make up each garment, e.g. fronts, backs, pockets, sleeves, cuffs, collars and panels, are tied together into bundles (Stone, 1999:174) and are ready to be assembled.

Garment assembly involves joining fabric pieces into a garment. Failure to monitor quality at all stages of apparel production may lead to poorly assembled apparel and subsequently to apparel fit problems. Apparel size and fit may be altered at any of the sewing stages. For example, garment size may be reduced by taking in more seam allowances, taking excessive trims with sergers (Ashdown *et al.,* 2007:364). On the other hand, taking in smaller seam allowances than originally allowed in the patterns, not trimming sufficiently with sergers or not matching notches, incorrect easing of one piece of fabric into another or puckered seams, lead to garments becoming shorter or smaller than intended (Ashdown *et al.,* 2007:364), and may consequently result in poor fit. Garments are joined in sections and once these are joined, the final touches such as trims and buttons are added. Inspection must be conducted throughout all assembling processes as a quality control measure to ensure that apparel conforms to size specifications.

Apparel finishing includes adding final details and trimmings that cannot withstand wet processing. Wet processing includes softening processes such as garment rinsing, washing, bleaching, stone or acid washing, and colour addition like dyeing (Ashdown *et al.,* 2007:366). Thereafter, garments are inspected and repaired to rework defects. Final inspection includes measurement of sampled garments to ensure that correct size and dimensions of the garments are maintained throughout the production and finishing processes (Ashdown *et al.,* 2007:366). Ashdown *et al*. (2007:366) record that as much as 20% of clothing produced do not meet the expected standards and as a result will probably not give good fit to consumers. After the final inspection, accessories such as belts, ties or flowers are added and paper tags and size stickers are attached. It is important that correct sizes are attached to the correct garments, as garment labelling mistakes may consequently affect garment fit (Ashdown *et al.,* 2007:369). Incorrectly sized apparel may lead to consumers' distrust of apparel brands' size labelling systems (Ashdown *et al*., 2007:367), and consequently, discontinued purchases of the apparel brand concerned, and loss of revenue to retailers and manufacturers. Garments are then folded or hung and packaged in readiness for distribution.

2.4.6 Distribution

Distribution is the method of delivering apparel products to consumers (Keiser & Garner, 2003:163). Manufacturers produce apparel for different companies with different target groups. Therefore, multiple garment sizes are produced from different sizing systems at the same time, as required by the different companies. Each of the many orders may also be distributed to different geographic locations (Ashdown *et al*., 2007:368). Subsequently, the different companies may be distributing their RTW apparel to different outlets. They therefore need to distribute appropriate apparel for specific target consumers for whom the apparel was designed and manufactured. Since different companies' target markets have different figure shapes and sizes, manufacturers need to ensure that from packaging up to distribution, these differences are taken into consideration. Manufacturers also need to identify retailers that will optimise the availability of the merchandise to the target market (Ashdown *et al*., 2007:369).

2.5 READY-TO-WEAR APPAREL FIT ASSESSMENT

The second component highlighted as B in the Ashdown's model (**Figure 2.1**) is fit issues. Keiser and Garner (2003:315) define fit as "the conformance of the garment to the body shape and size of the individuals who wear them". Well-fitting clothes are those that match the human body without forming wrinkles, provide sufficient ease of movement and are cut and manipulated in such a way that they appear to be part of the wearer (Keiser & Garner, 2003:315). Good fit is an important factor that apparel consumers seek for when purchasing RTW apparel. Fit problems are caused among other things by the lack of up-to-date and accurate data on which the manufacture of clothing could be based. They also may emanate from failure to classify the target market into different body shape categories, as well as carelessness in apparel designing and construction. Classification of body shapes may facilitate the production of better-fitting apparel for the different body shapes (Brown, 1992:161). Furthermore, Bougourd (2007:130) emphasises that the quality of apparel fit may be impacted throughout the different stages of apparel production as well during its use. This then necessitates measures to ensure effective fit assessment methods at all the apparel production stages and also during the use of the apparel products as suggested in the highlighted component (marked B).

As mentioned earlier, the apparel industry has been struggling for a very long time to supply consumers with well-fitting clothing and as a result, a number of consumers are experiencing difficulties in finding well-fitting garments (Kurt Salmon Associates, 2000). According to Petrova and Ashdown (2008), the fit of apparel depends on the size and shape of a particular body, and is correlated to the difference between the body and the garment. Understanding how all these relate holds a potential for improving sizing systems for RTW apparel in terms of garment fit. Garments that fit well are not only more attractive than ill-fitting ones, they are also more comfortable and durable (Rasband, 1994:3). Moreover, good fit is an important factor for consumer satisfaction.

Keiser and Garner (2003:315) define fit as "the conformance of the garment to the body shape and size of the individuals who wear them". The definition of apparel fit varies over time and is also dependent on the fashion culture, industrial norm, and individual's perception. Fit is also defined as the relationship between size and contours of the garment and those of the human body (Chen, 2007). Well-fitting clothes are those that match the human body without forming wrinkles, provide sufficient ease of movement and are cut and manipulated in such a way that they appear to be part of the wearer (Fan, 2004:31). The fit of any garment depends on the five elements of fit, which are ease, grain, line, set, and balance (Hudson, 1980; Keiser & Garner, 2003:315; Marshall *et al*., 2004:321; Chen, 2007).

Well-designed apparel should provide sufficient room known as ease so that it does not restrict body movements (Brown & Rice, 2001:158). Ease can be achieved by adding an allowance to the body measurements. It is defined as the dimensional difference between the garment and the individual wearing it as intended by the designer (Brown & Rice, 2001:158). There are different forms of ease: wearing/fitting/comfort or functional ease and design or styling ease (Brown & Rice, 2001:159). Wearing ease is the amount of fabric allowed for body movement, whereas design or styling ease is the amount of fabric required by the designer to create a desired appearance, style and silhouette Marshall *et al*., 2004:321. The amount of ease is determined by the choice of material, style, function, body location and personal preference. Without sufficient wearing ease, poor fit results as characterised by clothing pulling, straining and binding uncomfortably against the body, thus emphasising the less desirable body contours and figure variations (Rasband, 1994:20; Brown & Rice, 2001:158-159; Marshall *et al*., 2004:321-322; Chun, 2007:132; Branson & Nam, 2007:264).

The next element of fit is line, which refers to how the structural lines of a garment conform to the lines of the body. A well-fitted garment should have vertical side seams perpendicular to the floor and should be parallel to the centre back and centre front seams when it is worn on the body. Curved lines should follow the contours of the body (Brown & Rice, 2001:158-159; Keiser & Garner, 2003:316; Chun, 2007:132). Grain lines indicate the direction of threads in a fabric and can be lengthwise and crosswise. Lengthwise grain in most garments is expected to run parallel to the height of the body at centre front and centre back, while crosswise grain then runs perpendicular to the lengthwise threads. A garment that is on-grain will fit well, hang evenly and appear symmetrical, while a garment that is off-grain will be crooked (Keiser & Garner, 2003:316; Chun, 2007:132). Set refers to the absence of unwanted wrinkles on garments. The appearance of wrinkles is often an indication of improper fit. It could either mean the garment is too small and the fabric pulls, or the garment is too large and the fabric sags (Keiser & Garner, 2003:315). Lastly, balance determines how even the left and right sides of the body appear when examined from different angles. Poor balance can result from poor construction techniques or poor posture (Keiser & Garner, 2003:316). To achieve satisfactory fit for different figure shapes within a population, it is imperative that all the elements of fit discussed above are combined, based on accurate and up-to-date body measurements of the target market.

According to McVey (1984), 70% of garments on marked down racks are due to poor fit and poor workmanship. Fit problems are caused among other things by the lack of up-to-date and accurate data on which apparel manufacturing could be based. They also may emanate from failure to classify the target market into the different body shape categories as well as carelessness in apparel designing and construction. Classification of target markets may facilitate the production of better-fitting apparel for the different body shapes within a population (Brown, 1992:161). Furthermore, most of the fit problems that are attributed to figure variations in body contours, posture and proportions, may be minimised. Incorrect and inconsistent sizing by the different apparel manufacturers is also another major reason for the confusion experienced by consumers during garment selection (Workman, 1991; Pisut & Connell, 2007).

2.5.1 Ready-to-wear apparel fit perception

Fashionable clothing is manufactured based on an ideal figure and therefore reflects a standard body shape. When women do not conform to the ideal figure and subsequently standard apparel, they tend to blame their bodies for the improper fit and view themselves as imperfect rather than the clothes (LaBat & DeLong, 1990). If clothes do not fit well consumers' attitude and ultimately their self-concept will reflect those feelings, especially if poor fit is a consistent problem in all their apparel shopping experiences (Pisut & Connell, 2007). This leads to consumer dissatisfaction with their bodies. Young African and Caucasian women are the main focus in this study. They, like any other consumer segments, require clothing that fits well. A study conducted in the United States of America by [TC][2] (Bougourd (2007:124) showed that black women were larger than their White counterparts. Another study by Winks (1997) revealed that the body dimensions of African men were generally smaller than those of Caucasian men in South Africa. It is therefore imperative that the body measurements of young African and Caucasian women be investigated to establish the differences.

Apparel fit perception is judged by the wearer based on the appearance or the awareness of how garments look on the wearer and how comfortable they are. It is the evaluation of comfort based on physical and visual characteristics of garments. Satisfaction with apparel fit and appearance may be influenced by the wearer's level of satisfaction with his/her body or parts thereof (body/body part), i.e. cathexis (Ashdown & DeLong, 1995). Fan (2004:33) also records an investigation of fit perception from consumers' viewpoint and concluded that body cathexis plays a pivotal role in the perception of fit by individuals. Findings of the same study revealed that women who were satisfied with a particular part of their body preferred a definite fit around that area. Furthermore, the same study shows that body cathexis and apparel fit are influenced by consumers' body size and shape. It is therefore concluded that fit is a subjective concept, as each consumer has a different perception and preference of how a garment should fit and feel on different body parts. If a garment fits tightly, the wearer may be uncomfortable and can even feel bad about themselves and their appearance (Le Pechoux & Gosh, 2002:11; Chen, 2007).

2.5.2 Ready-to-wear apparel fit and wear testing (fit quantification)

As part of fit quality evaluation there is apparel fit perception (highlighted in **Figure 2.1**) that is judged by the wearer, based on the appearance or the awareness of how garments look on the wearer and how comfortable they are. Fit evaluation is the process by which the interaction between the garment and the body is analysed based on predetermined criteria (Brown & Rice, 2001:159). Evaluation of fit by the wearer is said to be subjective, as two individuals with the same body measurements may perceive fit differently (Alexander *et al*., 2005). Fit evaluation conducted by the use of technology and/or trained experts who follow certain predetermined criteria to analyse fit provides reliable and valid data and is therefore believed to be more objective (Ashdown *et al*., 2004; Chen, 2007; Choi & Ashdown, 2007:265). Fit testing is a method of evaluating garment fit on live models.

Wear testing, on the other hand, is having subjects wear the garment for a specified period of time. Thereafter, the garment is cleaned using suitable methods, at specified intervals, in order to evaluate how the garments respond to normal wear and handling. Wear testing is necessary to address issues of durability, garment performance and changes in fit over time (Keiser & Garner, 2003:51). Wear tests are conducted over time under uncontrolled conditions and wearers report subjectively on results. Wear tests can provide important information on the success of the garment under actual wearing conditions (Keiser & Garner, 2003:51). As highlighted in **Figure 2.1**, subjects' opinion of fit perception in this study were collected by means of participants' reports on RTW apparel fit problems that they experienced at selected fit points, namely: bust, stomach, waist, abdomen, hip, seat and thighs.

According to Fan (2004:31), objective fit evaluation assesses fabric properties that influence fit and is necessary yet difficult to achieve. The apparel industry has in the recent past introduced the use of technology in the evaluation of fit. The use of 3-D body scanning technology in apparel fit evaluation is anticipated to enhance objective fit evaluation.

Fit testing is a method of evaluating garment fit on live models. During fit testing the models analyse, assess and report on apparel fit. Thereafter the garment is adjusted according to their specifications. It is a process of verifying that garments designed for a specific size does indeed fit the dimensional specifications determined by the sizing system (Bougourd, 2007:134). Fit testing is an essential process in the manufacturing of apparel and therefore has to be conducted throughout the production stages. Fit testing is one way to achieve quality apparel and product differentiation (Bougourd, 2007:134). Apart from testing fit on live models, fit can also be tested using body scanning and body forms. Testing for fit can also be carried out on prototypes while the sizing system is being developed (Bougourd, 2007:134). According to Rosenau and Wilson (2001:261), a prototype is the first critical opportunity for apparel product developers to see an actual garment style and try it on a fit model. This is an opportunity to evaluate the aesthetic and functional attributes of apparel styles on the human body. Fit testing can also be performed on a regular basis as well as at the end of production lines, as part of quality control (Bougourd, 2007:134). Fitting sessions allow the relationship between the human body and the apparel to be judged and to determine whether the styling and fit are suitable for the body shape.

However, according to Keiser and Garner (2003:328), in order to produce well-fitting apparel, the fit models selected should represent the body variations prevalent in the target population (Bougourd, 2007:134). To ascertain apparel fit, assessing teams work together with fit models to check the physical characteristics that would be difficult to evaluate by simply viewing the garment. Grain and stretch properties of materials, line, balance, set of the garment and the ease interaction with both the design characteristics and the human dynamics are evaluated (Bougourd, 2007:134). Fit models have an advantage over dress forms as they report on the comfort of the garment experienced at different body postures and movements. During fit testing sessions, the areas of concern are apparel fit, design and fabric in relation to comfort. Once the sample garments are approved, apparel production commences, but if further fit problems are anticipated, more wearer trials may be conducted (Bougourd, 2007:134).

2.6 COMMUNICATING SIZING AND FIT ISSUES

Chun (2007:220) stated that an effective sizing system should aim at communicating apparel sizing and fit efficiently to the consumer (highlighted and marked C in **Figure 2.1**), and in turn consumers should give feedback on apparel fit and performance to manufacturers. Garment sizing is a tool that guides customers when selecting apparel (Brown & Rice, 2001:146). Even though size labels are beyond the scope of the present study, they are one of the factors that may contribute to RTW apparel fit problems if they do not guide consumers during apparel selection. Size and fit labels should therefore contain information that helps consumers identify appropriate garment sizes and to subsequently make informed purchase decisions (Brown & Rice, 2001:147). It is therefore necessary that information on size labels is reliable and easy to understand. Furthermore, size labels should be designed so that they inform consumers on garment suitability for the different body dimensions and shapes (Brown & Rice, 2001:147). This could limit the number of garments a consumer tries on (Petrova, 2007:56-57; Yu, 2004:184) and also help them select appropriate apparel styles and sizes.

The International Standards Organization (ISO) made recommendations that key body dimensions should be indicated on size labels. However, Strydom and de Klerk (2006) observed that the sizing system used in South Africa does not indicate the body measurements and shapes of consumers for which the garments are produced. This could be attributed to the fact that the South African Bureau of Standards has not published standards for sizing women's apparel (Yu, 2004:176). Istook and Hwang (2001) also concur that most sizing systems do not indicate the body shapes the garments are designed to fit. Yet body shapes are the frame on which apparel fit is assessed, and their classification is therefore a key element for a successful sizing system. Subsequently in South Africa, different apparel retailers use different size labelling that reflects different measurements (Strydom, 2006). The same study observed that the sizing system and coding on ladies' wear is a numerical code indicating apparel size that is not always related to body measurements, unlike in men's wear where the size code and body measurements are related.

Glock and Kunz (1995:108) also noted that size labels that indicate height, i.e. whether the garment is meant to fit tall or short figures, minimise fit problems. Additionally, there is lack of standardisation in apparel industry practices, for example, in methods of pattern development, pattern grading, apparel production and sizing, results in inconsistent apparel fit. Variation in apparel size is observed in similar or different brands produced by similar or different manufacturers (LaBat & DeLong, 1990; Workman & Lentz, 2000; Brown & Rice, 2001:153). If size labels were to indicate body shapes and sizes that the apparel was made to fit, it may limit the number of garments a consumer tries on (Yu, 2004:184) which damages the apparel. Failure to identify their size sooner may result in consumer dissatisfaction, even if they eventually find their sizes (Petrova, 2007:59).

Furthermore, consumers can become frustrated when sizes vary from one manufacturer to the next and from one brand to the other. Chun (2007:221) confirms that a number of researchers attribute fit problems to the lack of standard sizes among manufacturers globally. Vanity sizing has resulted in consumer sizes becoming smaller yet the population's dimensions are becoming larger (Brown & Rice, 2001:146). It aims to flatter consumers who want to think of themselves as wearing smaller sizes than their actual body dimensions, for example, a woman who is a size 14 may fit in a size 12 or an even smaller size (Tambarino, 1992a; 1992b; Ashdown & De Long, 1995; Glock & Kunz, 1995:111; Brown & Rice, 2001:146; Keiser & Garner, 2003:304; Chun, 2007:234).

2.6.1 Apparel size labelling

Chun (2007:227) reveals that the differing size labelling systems used in different parts of the world have contributed to global sizing and fit problems. Glock and Kunz (1995:110) define a size label as a source of information about fit. Size labels differ, others are informative and some are uninformative. Informative or self-explanatory size labels give important information about the body dimensions of the target market the garments are designed to fit, whereas uninformative size labels contain meaningless information (Brown & Rice, 2001:146). Informative labels vary; some contain symbols only, i.e. wordless pictograms, other pictograms show key body dimensions, and others show size codes with key dimensions. Pictograms are symbols that communicate the body dimensions of the target market that the garments are meant to fit, and they are preferred by most consumers (Brown & Rice, 2001:146).

Another common size labelling system used internationally is generic sizing codes such as S for small, M for medium, L for large, XL for extra-large, and so on, which are general indicators of body size. Lettered sizing allows size categories to be collapsed into fewer categories. However, their disadvantage is that consumers cannot find accurate fit compared to numbered sizes. Numbered sizes provide finer differences between sizes (Brown & Rice, 2001:148). These generic size codes are normally used in the sizing of loose fitting clothes such as sweaters, T-shirts or sportswear in general (Glock & Kunz, 1995). One-size-fits-all is another sizing system through which manufacturers collapse sizes by providing garments that have the ability to stretch to fit many size groups (Brown & Rice, 2001:148). Like the generic size codes, one-size-fits-all apparel is expected to fit figure shapes especially extreme sizes. A possible solution to the sizing problem and dilemma lies in the inclusion of the body measurements and the body shapes that the garment is designed to fit (Brown & Rice, 2001:148).

Numbered sizing is the most commonly used sizing method for mass produced RTW apparel. However, consumers often complain that different brands and styles of similarly numbered sizes fit differently. Most women's clothing is sized in codes or numbers which sometimes correlate with bust, waist, hip girth, and height (Chun, 2007:234). However, in some cases these codes are vague and do not correspond directly to any actual body dimension and therefore do not assist consumers during apparel selection; as a result, this contributes to apparel fit problems (Chun, 2007:234). This is an indication that in some size labelling systems, the numbers have no real meaning for many female consumers (Chun, 2007:235).

2.7 CONCLUSION AND IMPLICATIONS FOR THE STUDY

This chapter has focused on the complex issue of RTW apparel fit and some of the factors that impact on apparel fit perception. From an in-depth literature search, the main concepts that influence RTW apparel fit were identified. Ashdown's model forms the theoretical framework on which the study is based. This study suggests that the main components of this model need to be based on accurate and up-to-date measurements of the population, as well as on prevalent body shape classes. The three-dimensional body scanner was selected and used to capture participants' virtual images, from which measurements were extracted. This data may address the issue of out-dated and foreign data that is currently used in the South African sizing system. Body scanning is currently the best method of taking body measurements. This study may be the starting point in the compilation of local data that may address the issue of inconsistent, out-dated and foreign sizing systems currently used in South Africa. The body shapes identified among African and Caucasian women should therefore form the basis for apparel production. Apparel designs and styles chosen must be suitable for the different body shapes. Also, the different manufacturers need to adopt a standard sizing system to eliminate the problem of inconsistent sizes that are a major source of apparel fit problems. Thereafter, the apparel produced need to bear size labels that reflect the apparel size, the body dimensions and the body shapes of the target population, instead of the arbitrary or vague numbers and codes currently used. This can be achieved by the use of pictograms which are the most favoured of all size labels, and in addition to body shape, they should also reflect body measurements. The literature shows that size labels used by the South African industry still do not indicate the body shapes of the target population Strydom (2006). The consumers need to be informed about their key measurements and body shapes, the understanding of which will help make their apparel search and selection easier, resulting in consumer satisfaction and loyalty. Consequently, apparel returns due to sizing and fit problems could be minimised. As highlighted above, manufacturers use size labels to convey sizing and fit information to the consumers. On the other hand, consumers' post-purchase reactions communicate their satisfaction or dissatisfaction with the apparel by their retaining or returning it respectively. Finally, if all components of an effective sizing system could be taken into consideration and could be based on the body shapes and measurements of target markets, an effective sizing system could be achieved and apparel fit satisfaction could be enhanced. Size labels form the method that apparel manufacturers use to communicate with consumers. After all, Ashdown's model emphasises the importance of communication of sizing and fit issues between consumers and manufacturers.

CHAPTER 3: SUPPORTING LITERATURE REVIEW

3.1 INTRODUCTION

This chapter presents an in-depth literature review of concepts relating to RTW apparel fit of different body shapes and body shapes characteristics, as well as other factors influencing the fit of RTW apparel. These include body shape characteristics, consumer fit preferences and body cathexis, and how these impacts on RTW apparel fit, and also perceived fit problems associated with the different body shape characteristics. An understanding of these concepts is crucial as it may contribute towards the production of better-fitting apparel and provide consumers' with knowledge on appropriate apparel designs, styles and sizes for their different figure shapes, and that might minimise apparel fit problems.

3.2 THE ROLE OF BODY SHAPE IN RTW APPAREL FIT

The literature (Zwane & Magagula, 2006) indicates that target markets or populations consist of consumers with different body dimensions and shapes, and that these differ within and between populations (Simmons *et al*., 2004a; 2004b; Lee *et al*., 2007; Shin & Istook, 2007). Winks (1997) and Workman (1991) suggest that if good apparel fit is to be achieved, it is important for apparel manufacturers to re-evaluate the prevalent body shapes within populations and to configure them with the population's measurements from time to time. They further state that body measurement charts and companies' basic blocks need to be revised and changed as the silhouette changes. According to Ashdown (2000), an effective sizing system classifies the target population into different body size categories. The inclusion of body shape classes in the sizing systems may form a basis for the production of RTW apparel with improved fit (Simmons *et al*., 2004a; 2004b). Connell *et al*. (2003) argue that body size is not related to body shape, as shape does not depend on size. They further suggest that people who wear the same RTW apparel size cannot be assumed to be the same shape, and that individuals vary from small to large or short to tall within the same apparel size category.

Connell *et al*. (2003) record that the apparel industry is beginning to realise the importance of body shapes, as two people with identical key dimensions will not fit in the same garment the same way if their bodies are shaped differently. Most sizing systems base figure shape classification on dimensions such as height, while other systems identify certain figure characteristics, profiling the different body parts either above or below the waist by proportions of body circumferences. Others, e.g. Connell *et al*. (2003), outline body shapes by describing the whole body and or parts thereof, for example the front and side view perspective. All of these methods of body shape classification address the relationship between the body dimensions of the human body (Simmons *et al*., 2004a; 2004b). Moreover, understanding body shape characteristics is important for both the individual consumer and the apparel industry. Consumers who understand their body shapes are able to select apparel that complements their bodies. Furthermore, knowledge of physical body shape differences among consumers enables the apparel industry to better serve them by designing and producing apparel suitable for the different body shapes (Marshall *et al*., 2004:377).

Alexander *et al*. (2005) compared general RTW apparel fit problems of the different body shapes. Most rectangular, triangular and hourglass shaped women reported fit problems at the bust than the inverted triangular shaped women. This could be attributed to the average to fuller bust of the rectangle and hourglass shapes as well as the smaller bust of the triangular shaped women. The hourglass, triangular, rectangular and inverted triangular shaped women also expressed fit problems at the waist, hips and thighs (Alexander *et al*., 2005). These fit problems may be due to the proportionately smaller waist of the hourglass and triangular shapes, the average to larger lower bodies of the hourglass, triangle, rectangle shapes as well as larger waist of the inverted triangular shaped women. Li *et al*. (2003) observed that rectangular shaped women experienced apparel tightness at the waist, abdomen, hips, buttocks and thighs. These problems may also be attributed to the average to large body that is almost equal from shoulders to the hips.

Variation in figure shapes of the South African apparel consumer population is to a large extent attributed to the diverse ethnic groups. According to Strydom and de Klerk (2006), the South African apparel industry does not cater for the varied prevalent body shapes hence the fit problems currently experienced. Research confirms that body shape varies not only with ethnicity but also with age (Connell *et al*., 2003), and therefore if satisfactory apparel fit for multicultural consumer populations is to be achieved, the basic patterns used should be as varied as the body shapes prevalent within the different ethnic and age groups in the population. Furthermore, the South African clothing manufacturers need to ascertain the variations in body size and shape of the different ethnic groups in order to better serve most consumers in the market.

When constructing RTW apparel it is crucial that attention is directed to the differences that exist among different population groups, as this may help minimise fit problems. Traditionally, garment pattern construction relies on circumferential and arc body measurements rather than on width (side-to-side in frontal view) and depth (front-to-back of side view) measurements (Petrova & Ashdown, 2008). Hence, it is important that body shape and size variations be explored from the front and side views of the body, the significance of which must be established if well-fitting clothes for a population as diverse as the South African are to be manufactured. This may also help clothing manufacturers ascertain whether RTW apparel designed to fit one ethnic group can be assumed to fit all the other groups. If not, the different groups with significantly different body shapes and proportions will need to be identified, so that suitable base patterns that are representative of the relevant body shapes be developed to help produce garments with satisfactory fit (Winks, 1997). The findings of the study by Winks (1997) reveal that the body dimensions of Black males were generally smaller than those of Caucasian males in South Africa. It is crucial therefore to determine how body shapes of young female African and Caucasian women compare.

Yu (2004:31) compiled diverse definitions of fit which reflect it as a complex and difficult construct to study. Yu (2004:31) describes well-fitting clothes as those that conform to the human body with sufficient ease of movement, have no wrinkles and appear to be part of the wearer. Keiser and Garner (2003:315) summarise fit as “the conformance of garments to the shape and size of the individuals who wear them”. Rasband (1994:3) states that good fit is achieved when a garment hangs smoothly over the figure without clinging, binding, pulling, gaping, twisting or hiking up. Straight seams and hems of well-fitting apparel should be parallel to the floor unless intentionally designed differently. Loose fitting apparel makes one look larger than one actually is, and tight fitting clothes expose and emphasise less desirable figure variations (Rasband & Liechty, 2006:3). Zangrillo (1990:4) also states that good fit enhances the wearer’s appearance, increases feelings of self-worth, self-esteem and self-confidence, whereas poor fit makes one feel physically uncomfortable and unattractive. Poor fit is observed when tight fitting clothes pull, gape, and wrinkle, or when loose fitting clothes sag (Zangrillo, 1990:4; Rasband & Liechty, 2006:3) According to Locker, Ashdown and Schoenfelder (2005), there are multiple factors that contribute to what an individual perceives as good fit. As a result, individuals might have a preference for one degree of fit in one garment style, over a differing degree in another style.

As fashion changes, acceptable standards of good fit also change. According to Rasband (1994:12), there are three basic types of fit: close fit, loose fit, and very loose fit. To achieve different kinds of fit, varying amounts of ease are added or removed. For a loose fit, ease may be added, and if a close fit is desired, ease is reduced. There are ten garment parts that are critical in determining apparel fit. These are: neckline, shoulder seam, sleeve caps, sleeve length, bust shaping, bodice back, waistline seam, back darts, seat and hemline. A well-fitted neckline is supposed to rest smoothly on the collar bone in such a way that buttoned collars are fastened comfortably with ease. Well-fitting shoulder seams are expected to lie straight across the top of the shoulder and sleeves to fit smoothly around the armhole (sleeve head or cap), with enough ease around the elbow; sleeve hems or cuffs for long-sleeved blouses must end at the wrist bone when the arm is slightly bent. On the other hand, jacket sleeves must allow 6 mm to 1.3 cm of blouse or dress sleeves to show and their lower hem must fall below the widest part of the hips, whereas coats' sleeves are supposed to cover blouse or dress sleeves by 6 mm to 1.3 cm (Brown & Rice, 2001:160; Marshall *et al*., 2004:322).

A well-fitting bust shaping design detail (e.g. a dart) is expected to be positioned at the fullest part of the bust and follow the bust contours. The bust dart has to end 2.5 cm to 3.8 cm below the bust point for size 14, and 5 cm to 6.5 cm below for larger sizes. Bodice back darts and shaped princess seams must fit the garment to the figure contours at shoulder blades and natural waist. Back darts should end at 1.3 cm to 1.5 cm short of the fullest parts of the shoulder blades as they serve as a shaping for apparel. Well-fitting lower garments should have enough ease to allow for bending and sitting without straining seams. Crotch seams are expected to follow body contours smoothly. Waistline seams of all garments must rest on the natural waist and waistbands should neither be too tight nor too loose. Hemlines should hang evenly at an equal distance from the floor and pants hems should just touch the top part of a shoe (Brown & Rice, 2001:160).

Keiser and Garner (2003:315) point out that fit problems arise when a contrasting relationship between the garment and the human body occurs. The lack of standardisation of sizes across different manufacturers and retailers is one of the causes for the prevailing fit problems. Moreover, manufacturers reduce their sizes from the existing standard sizes and produce smaller sized apparel than their competitors in what is known as vanity sizing (Tambarino, 1992a; 1992b; Ashdown & DeLong, 1995). This is done because women often feel better about purchasing and wearing smaller sizes than their actual sizes, and apparel firms believe that by reducing their apparel sizes, it gives them a competitive advantage over other manufacturers; this is said to be a profitable exercise and marketing strategy. However, this practice presents consumers with inconsistent apparel fit and further aggravates existing apparel fit problems (Desmarteau, 2000). Several studies, as outlined in **Chapter 2**, emphasise that apparel production must be based on accurate and up-to-date body dimensions and body shapes of a target population.

According to Strydom and de Klerk (2006), it is imperative that apparel manufacturers strive to satisfy consumers as dissatisfied RTW apparel consumers may be compelled to discontinue apparel purchases, switch to other apparel brands, publicly complain about the product and or initiate negative word of mouth communication. Daanen and Reffeltrath (2007:206) state that apparel should be designed according to the wearer's body dimensions and body shape so that it conforms to the body. This can be achieved if consumers' body measurements are current, taken accurately and are used to classify consumers' different body shape categories. They may also be translated into patterns and be considered throughout the apparel manufacturing process to contribute towards the production of well-fitting apparel.

3.3 FEMALE BODY SHAPE CLASSIFICATION METHODS

3.3.1 The history of body shape classification

Body shape classification has evolved over the years. In the 1930-40s, Sheldon used the somatotyping technique to classify and come up with distinct body shapes. These are: endomorph, mesomorph and ectomorph. Endomorph refers to a body that is round, soft with little muscle development and tight skeletal frame. Mesomorphs have massive skeletal development, heavy bones, broad chest and resilient muscles. Ectomorphs have a frail skeletal frame, lightly boned, and delicately muscled, with narrow chests (Marshall *et al*., 2004:138). Douty (1954; 1968a; 1968b; 1968c) adopted and further developed Sheldon's body shape classes, and came up with graphic somatometry or photography as a less invasive method of analysing body build and posture. Silhouettes of female subjects were projected through a grid screen. Thereafter the somatographs were analysed for posture, general body mass, proportion, contour, balance, and symmetry of the body. This was achieved by adding 5-point body build and 5-point posture scales, using front and side views respectively. This method was able to identify body variations in forms and shapes (Kwong, 2004:201).

Later on, Minott (1974; 1978) categorised and analysed the lower and upper bodies using the hip shape and posture type for lower body as well as posture, neck width and length, shoulder width and height or slope, chest shape, bust size and bust location, back width and back curvature and arm size as well as waistline characteristics for upper body. The whole body was classified using prominence of the bust, buttocks, abdomen, as well as shoulder, back, arm, hip, leg types, bust and back relationships. While some of these physical characteristics within these experts' scales could be determined by tape measures, other shape variations could only be distinguished visually.

Gazzuolo (1985) explored the visual dimensions of female shapes based on variances in pattern shapes from the central plumb line. Subjects' bodies were classified based on the frontal and side views. The same study further anticipated the use of both 2-D and 3-D tools to understand female body shapes relevant to pattern development. This combination resulted in a more precise body shape analysis than anticipated by Gazzuolo (1985).

Thereafter, the Body Shape Assessment Scale was developed, which defined four body shapes, namely: hourglass, pear/triangle, rectangle and inverted triangle. It also included a scale for whole body analysis, body build, body shape, posture and component body part analysis for torso shape, hip shape, shoulder slope, bust shape, buttocks shape and back curvature. The Body Shape Analysis Scale was created using expert analysis of 3-D body scan data, and was validated through practice and implementation of the scale to classify body scan data (Simmons *et al*., 2004a; 2004b; Connell *et al*., 2006)

The Female Figure Identification Technique (FFIT) was developed and validated in the US. This software uses body scan measurements data as input and classifies subjects into one of nine distinct body shapes. These body shapes are: hourglass, bottom hourglass, top hourglass, spoon, rectangle, diamond, triangle and inverted hourglass. The FFIT uses six circumferential measurements to classify subjects' bodies, namely: bust, stomach, waist, abdomen, hips and high hip (Devarajan & Istook, 2004; Simmons *et al*., 2004a; 2004b).

Connell *et al*. (2006) classified body shapes using drop-values, i.e. the relationship between bust, waist, hips as indicators of shape differences. Other studies identified landmarks to aid computational and visual shape analysis (Gazzuolo, 1985). However, with the technological advancement of the 3-D body scanner, there is now no need to landmark the body since a body scanner has predetermined landmarks that are used to plot data points of the participants' images. Connell *et al.* (2006) further suggested the moderate revision of body shape classification by introducing the visual analysis of body built, posture and expansion of shoulder height, hip shape, abdominal shape, shoulder blades/back shapes, and the addition of bust prominence and buttocks prominence to come up with more variations within each shape.

Drop value is one method of body shape classification used in a number of studies (Simmons *et al*., 2004a; 2004b; Lee *et al*., 2007). The drop values were incorporated into the mathematical description of body shapes classification parameters, as used in a study by Lee *et al*. (2007). This study combined two or more mathematical formulae to define each body shape category. For instance, the classification of the hourglass shape was based on the drop value bust – waist ≥ 22.9 cm or hips – waist ≥ 25.4 cm; for the triangle shape the drop values hips – bust ≥ 9.1 cm and hips – waist < 22.9 cm were used; to classify the inverted triangle, the drop value bust – waist < 22.9 cm was used; and the rectangular shape had drop values bust – waist < 22.9 cm and hips – waist < 25.4 cm. Mastamet-Mason (2008:151) modified and used the above parameters, formulae and drop values of a different sample to successfully classify the body shapes of Kenyan women. The drop values were used in combination with the formula Mean ± Standard Deviation within the minimum and maximum drop values to differentiate the body shapes. The resulting formulae for the five predominant body shapes were 14.0 cm ≤ hip – bust ≤ 26.0 cm for triangle; 8.0 cm ≤ hip – bust ≤ 3.2 cm (min) for inverted triangle; 23.0 < bust – waist ≤ 36 cm (max) for hourglass; 4.7 cm < bust – waist ≤ 23.0 cm for rectangle; and 13.0 cm (min) ≤ bust – waist ≤ 4.7 cm for apple. Mastamet-Mason further suggested that body shape defining parameters should be based on the populations' measurements.

The current study used the differences (drop values) between bust and waist and bust and hip circumferences as well as the scan images (photography) to classify and differentiate body shape characteristics of African and Caucasian women. The 3-D scan images show the participants' front and side views. These were visually analysed to confirm the body shape classes assigned from the measurements. Experts then visually analysed the bust, waist and hip relationships on the front view images as well as the body protrusions from the side view images of participants' scan images. This analysis enabled them to confirm the body shapes classified from the measurements. However, it should be noted that while in the present study, the body scanner extracted participants' 3-D virtual images, the data output gave a 2-D image of the participants' body. A brief overview of the different methods and techniques used to classify body shapes in different parts of the world is given next.

3.3.2 Female body shapes classification in different parts of the world

Different countries use different methods to classify female body shapes. Most countries such as England, Germany and Hungary classify body shapes by height and drop value (difference in hip and bust circumference) (Yu, 2004:185). The UK identified three figure types according to height: short (155 cm), average (155 to 162.5 cm) and tall (165 cm and above), and each height category was further divided by bust circumference into six figure shapes. These are extra-large bust (4” larger than hips), large bust (2” larger than hips), full bust (same size as hips), medium bust (2” less than hips), small bust (4” less than hips) and very small bust (6” less than hips) (Yu, 2004:185-86). In Germany and the Netherlands they used height and hip types to come up with nine body shape categories. From three height categories (average/normal, short and tall for Germany, and in the Netherlands: 1.60 m, 1.68 m and 1.76 m), the body shape categories were further divided into three hip shape categories: slim/small, average/normal and full/wide hip shapes (Yu, 2004:186). In Austria, women’s body shapes were classified into two height categories: short and normal. The Korean Industrial Standard Association classified women into the following five height groups: 150 cm, 155 cm, 160 cm, 165 cm and 170 cm (Yu, 2004:186). In Canada, the classification was based on three height categories: 155 cm, 163 cm and 171 cm, to come up with junior, misses and women respectively (Yu, 2004:186). In Czechoslovakia, figure shape categories were based on drop values (hip minus bust) of 6–10 cm Figure A, 4–12 cm Figure B and 7–8 Figure C (Yu, 2004:185-86).

In the United States, the early commercial standard (CS215-58) came up with 20 figure shapes from height and hip size determined by drop value. Earlier, the USA size labelling systems of women’s clothes was based on age or body measurements, then on body configuration (Keiser & Garner, 2003:302). These shapes were revised to come up with the following female sizes of different body types and ages: misses, petites, talls, women’s petites, juniors, junior petites, half-size women, plus size and maternity (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186), as described below:

Misses

This is a size category designed to fit adult females of average build, youthful figures and height, which at first was ranging from 5’ 5” to 5’ 6” but then changed to 5’ 5” and above. The Misses size categories included even-numbered sizes from 2 to 20. Previously, most retail outlets stocked sizes from 6 to 16; however, later on, sizes 2 to 4 were also included and sometimes even sizes 00 and 0. But it was observed that more than half the US female population was larger than size 14 and that the bust size of most of the sizes was were different from the ASTM standard, due to vanity sizing (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

Petites

This is a size category of shorter women who are below average height 5’ 4” and of average build. The ASTM standard includes even-numbered sizes 2P to 20P which is for women with similar circumferences as those of Misses sizes, but scaled down in height. Later on, sizes

16P and 18P were introduced to cater for larger petite. Only a few apparel retail outlets stock up to size 20P. Again manufacturers increased the circumferential measurements while maintaining the size numbering, resulting in smaller sizes of 00P and 0P among petite adults, whereas Petite sizes are meant for shorter women who are below average height. Petite sizes usually bear the letter "P" after the size number, e.g. size 2P (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

Talls

The Talls size category is designed for women of average circumferences and above average height up to 6' 1" like misses sizes except they indicate that they are aimed for consumers who are taller than average. Some apparel brands offer "Talls" size categories along with Misses sizes, especially for bottom apparel such as skirts and pants (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

Women's

Sizes for mature adults of average build, height and fuller weight than Misses are categorised as Women's sizes and bear the letter "W" after the size number, e.g. 16W. This figure category was revised in 2004 to include the women plus sizes 14W to 32W, overlapping the circumferences in sizes 16 to 20, with the assumption that women were 5' 6" and above in height, beginning with size 14W or 16W for women of average and moderate body build and rounder body contours. Other retail outlets also included size 12W for Misses size 12, with larger waist circumferences. Most retailers offer women sizes up to size 14W or 16W, and only a few retailers supply sizes 16W to 20W (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

Women's Petites (half sizes)

This category was designed for fully figured women who were shorter than average and their apparel were produced in half sizes. The half size category was replaced by women's petites for shorter figures with larger circumferences, with fuller torsos, shorter sleeves and hemlines in comparison with those of the Misses category. Sizes in this category ranged from 12WP to 20WP. This is a size category that is growing due to the prevalence of obesity among the USA population (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

Juniors

Junior size styles are designed for young girls or shorter adults with less developed bodies than the Misses category. Their size labels bear odd numbers 3 to 17, and a majority of retailers' stock apparel from sizes 5 or 7 to 13. This is a size category that suits women who are 5' 6" tall, with shorter torsos and longer limbs, and for less mature bodies than the Misses category (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

Petite juniors

This category was designed for very short women with average busts and fairly straight bodies. Size may be denoted as "5JP" or as "5P" (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

Plus size

This size category is for middle-aged to older adults, with the same proportions as the misses figure shape, but with full figures, i.e. larger waist and bust. Plus sizes are for larger sized, curvier women of average height, sometimes with lower bust lines, often designated by a W after the number such as 14W-24W. Like misses sizes, the sizes may be given as a dress size based on the bust measurement, but they are usually given as even-numbered sizes from 18 upwards. Categorical sizes usually range from 1X (similar to extra-large, but with slightly different proportions compared to the misses size). Some junior apparel lines also come in plus sizes and these would be uneven numbers higher than the usual range of 13: 15, 17, etc. In addition, instead of S/M/L, plus sizes are 1X, 2X, 3X, 4X (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

Maternity

This is a size category that was introduced by ASTM D7/97 for expectant mothers who have different sizing needs, resulting from changes in body shape due to pregnancy. Maternity sizes range from 2 to 22 was necessitated by the need of this niche market for fashionable wear during pregnancy (Keiser & Garner, 2003:302, 306-307; Marshall *et al*., 2004:313-314; Yu, 2004:186).

The literature records various methods used to classify women's figures, the commonly used methods being the ratios or relationships between specific parts of the human body. The bust to waist, bust to hip, and hip to waist measurement ratios (drop values) are regarded by many studies as key indicators of the different body shapes (Simmons *et al*., 2004a; 2004b). According to Chun-Yoon and Jasper (1993), figure shapes may also be determined by body development, body measurements and age. Another method classifies female body shapes by comparing the dimension of one body part to another or to the whole body, for example comparing bust, waist and hip circumferences (Simmons *et al*., 2004a; 2004b; Yu, 2004:185). Connell *et al*., 2006) suggested that another body shape classification method was evaluating body protrusion from the front, side and back views of the body to enable differentiation of bodies that have the same circumferential proportions but different width and depth proportions (Petrova & Ashdown, 2008). It is becoming apparent to the apparel industry that two people with identical key body measurements will not necessarily fit the same way into a garment of the same style and size, if their bodies are shaped differently (Connell *et al*., 2006).

Another method of classifying figure shapes is evaluating body protrusions, one body protrusion at a time. However, Petrova and Ashdown (2008) suggest that to comprehensively evaluate the body it is important that all the protrusions from the front, side and back must be evaluated at the same time. These protrusions may include: the bust, stomach, waist front, abdomen as well as upper back, waist back/curvature and buttock protrusions. Furthermore, one way to discriminate between two bodies that may have equal waist and hip widths but that are shaped differently or have different depths, is to combine width and depth projections as some bodies may have the same circumferential proportions but different width and depths proportions or have other different body shape-defining measurements such as lengths, heights, or angles, which result in failure to differentiate the shapes completely. Therefore, a more elaborate combination of circumferential or arc proportions along with depth or width proportions may be needed to define lateral body shapes fully. Additionally, body heights or lengths need to be combined with lateral body shape classes to achieve full body shape categorisation (Petrova & Ashdown, 2008).

When descriptions of different figure shapes are discussed, different terms come up, terms such as apple and pear, which are identifiers of fruits and vegetable shaped categories. Terms such as oval, circle, round, hourglass, diamond, rectangular, straight, ruler, triangular, spoon, Christmas tree, and cone belong to geometric shape categories. Similarly, another category of alphabets and numbers such as: “O”, “X”, “H”, “A”, “V”, “I”, “S” and figure 8 also come up (Workman, 1991; Chun-Yoon & Jasper, 1993; Ashdown, 1998; Istook *et al*., 2002; Li *et al*., 2003; Simmons *et al*., 2004a; 2004b; Connell *et al*., 2006; Zwane & Magagula, 2006). All of these terms can be confusing and appear misleading because a pear is shaped like a triangle, Christmas tree, cone and an “A” figure, by having a proportionately larger lower body (hip, buttocks and thighs) than at the (smaller) bust and hourglass, “8”, “X” shaped figures all represent a figure that is broader at the hip and bust, with a proportionately smaller waist. On the other hand, a rectangular and an “H” shaped figure represent a figure that has a bust, waist and hip that are almost equal in width. Similarly, an inverted triangular and a “V” shape are characterised by wider shoulders and bust, with a slightly smaller waist and even smaller hips. This then necessitates a need for summarised body shape categories, which some studies have successfully done.

Devarajan and Istook (2004) and Rasband (1994:12-13) summarise female figure shapes into eight body shape categories. Each body shape suggests an overall contour of the body and its proportions and patterns of weight distribution (Rasband & Liechty, 2006:24). These are the ideal, triangular, inverted triangular, rectangular, hourglass (bottom and top hourglass), diamond, rounded and tubular shapes. Spillane (1995:27-44) and Zangrillo (1990:4) went further to classify full-figured women, and discovered that these women may have the same height as their slimmer counterparts, except their bodies had fuller proportions. They further identified a rectangular-8 shape as an hourglass shape among plus size figures, and a barrel shape as an inverted triangular body observed among full-figured women. The other figure shapes (triangular, rectangular, diamond and rounded figure shapes) maintained a similar shape pattern in fuller figures as in regular sized women, except for the size. Understanding the physical characteristics of each body shape enables line, design, fabric scale and colour to be artistically combined in such a way that they complement the figure’s special qualities (Zangrillo, 1990:4). Moreover, body shapes determine how garments hang on the figure, how comfortable they feel and eventually how they are perceived to fit the consumer. Therefore individuals need to identify the body shape category most similar to their body shape, which should also be a guideline for easier apparel selection (Rasband & Liechty, 2006:24; Pisut & Connell, 2007). The present study adopted the six most common body shapes predominant in most populations, especially African populations, as identified by Mastamet-Mason (2008:151) and Mabuza (2012:103). These are the triangle, inverted triangle, rectangle, hourglass, oval/round/apple and diamond, as illustrated in **Figure 3.3**.

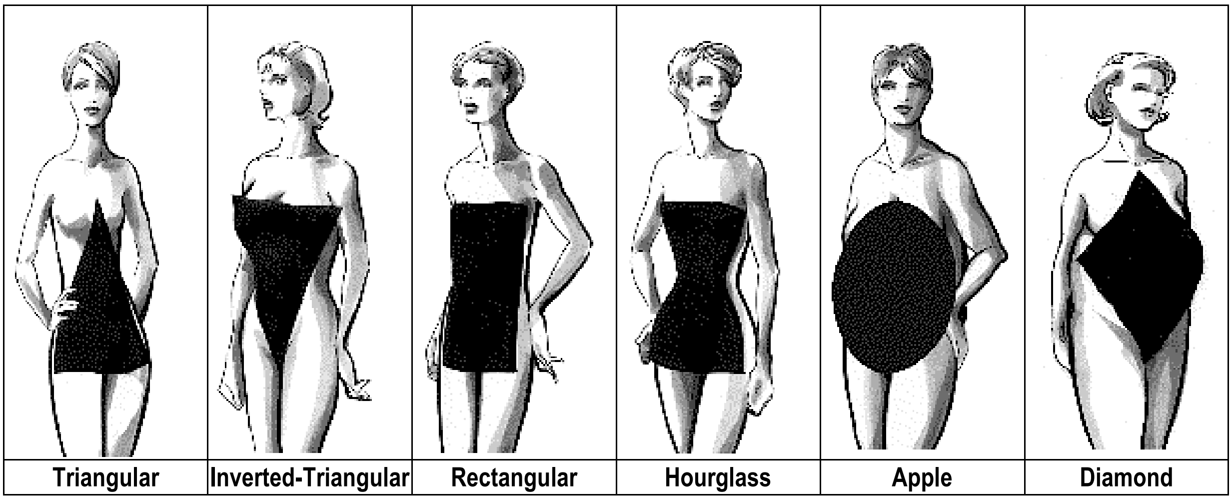


FIGURE 3.1: FEMALE PREDOMINANT BODY SHAPES (Source: Liddelow, 2011)

3.4 ESTABLISHED MAIN BODY SHAPE CATEGORIES

As pointed out earlier, an individual's body shape suggests the overall contours of the body, its proportions and patterns of weight distribution (Rasband & Liechty, 2006:24). It is becoming apparent to the apparel industry that two people with identical key body measurements will not fit the same way into a garment of the same apparel style and size, if their bodies are shaped differently (Connell *et al*., 2006). Therefore it is necessary for RTW apparel manufacturers to identify and study body shapes and body shape characteristics prevalent within populations to determine how they differ from one another as well as from the ideal figure. The extent to which a body deviates in shape and size from the ideal figure influences apparel fit. Body shape characteristics of the common body shape categories are compared to those of the ideal figure that is used by the apparel industry as a base pattern.

3.4.1 The ideal figure shape

An ideal figure is the figure usually selected as a standard figure by RTW apparel manufacturers. It is a body shape with well-proportioned and symmetrically balanced body components. Horizontal proportions such as the width across shoulder or bust and hip are assumed to be almost equal, and a waist that is about 25 cm smaller than both the bust and hip circumferences (Rasband & Liechty, 2006:23). This figure has a medium bust, a flat to slightly curved abdomen, moderately curved buttocks and slim thighs, with only enough weight to softly and smoothly cover the bones and hollows of the body (Rasband, 1994:12). In theory, an ideal figure can be equally divided into halves at the hip line, with an upper quarter that ends at the underarm level and a lower quarter ending at the knee level. Elbows are supposed to lie at the waist level, the wrist bone at about the crotch level and finger tips ending at mid-thigh. The elbows and knees of an ideal figure are supposed to cut the arm and leg into halves, respectively.

Fashion illustrations and runway models have slimmer, taller, and proportionately less curvaceous figures (Yu, 2004:33). They communicate that women with bodies differing from the runway models are imperfect, and this causes them to worry about being overweight. The Western hourglass shape is also acknowledged as the ideal figure by the fashion industry, and becomes in many cases the norm against which young women compare their own body shapes (Lin & Kulik, 2002; Pike & Rodin, 1991; Stice, Schupak-Neuberg, Shaw & Stein, 1991; Tiggemann & Pickering, 1996). Furthermore, when a certain body size and shape becomes fashionable, many people try to attain that size and shape. Consumers therefore need to understand how their proportions compare with the ideal figure, whether one's proportions are shorter or longer, narrower or wider. This enables consumers to select clothing that will flatter their figures and create an illusion of a proportionally balanced body and that is close to the ideal (Marshall *et al.*, 2004:377; Rasband & Liechty, 2006:23). Moreover, apparel fit perception is influenced by how consumers view their bodies in comparison to the ideal figure. Since there are very few women who conform to the fashion models, those whose figures deviate from the ideal figure become dissatisfied with both their bodies and also with apparel fit (LaBat & DeLong. 1990). The ideal body varies from one culture to the next (Apeagyei *et al*., 2007) and from one manufacturer to the next, which contributes to RTW apparel fit problems. It is also evident from the literature (Zwane & Magagula, 2006) that populations consist of consumers with body dimensions and shapes differing from those of the ideal figure. Individuals with different body shapes are therefore likely to experience apparel fit problems from apparel produced based on the standard body measurements and shape of an ideal figure (standard apparel). This is partly because the ideal figure is not a common figure shape among apparel consumers, as women on average have become larger and reflect a variety of body shapes and sizes (Simmons *et al*., 2004a; 2004b; Pisut & Connell, 2007). Therefore it is imperative for RTW apparel manufacturers to determine how the body shapes of their target markets differ from the ideal figure, in an attempt to understand their apparel fit needs.

Different cultures have different perspectives of an ideal figure. People from different ethnic backgrounds are influenced by their own standards of ideal beauty, which may be different from other cultures. Each culture has its unique attributes that set it apart from other cultures, i.e. they have their own definition of body ideals (Jung & Lee, 2006). Poorani (2012) observed that different cultures have different perceptions and definitions of an ideal figure. For example, Latin American view petite women with curves as ideal, Asian women view an oval face, black hair and average height as ideal, Indian and African women view healthy weight as ideal. However, the media portray an abnormally slim figure as an ideal figure, and in the Western culture, thinness is an important criterion of the cultural ideal of female beauty; being overweight is considered unattractive. Non-Western cultures are adopting the Western ideals as the ideal female beauty, and these are becoming standardised across cultures as the world is becoming a global village.

3.4.2 The hourglass figure shape

An hourglass figure shape is the one that has the bust and hip circumference equal in width and a distinctly smaller waist. Its bust ranges from medium to large, with a midriff and upper hips that taper towards a smaller indented waist, and it has smoothly rounded hips. Even though the hourglass figure has a balanced top and bottom, it is not considered a proportionate figure because of the very small waist that makes the bust, hip and buttocks appear proportionately larger. The hourglass figure has two figure variations, namely the top heavy and the bottom heavy hourglass. The top heavy hourglass figure has a wider bust than hip circumference, and the bottom heavy has a wider hip than bust circumference, both of which have a small, defined waistline. To minimise any confusion around these terms, the hourglass figure referred to in this study is the typical hourglass figure with hip and bust circumferences that are almost equal and a smaller waist (Zangrillo, 1990:5; Rasband, 1994:13).

Some literature (Zangrillo, 1990:5) reveals that fuller figures have a slightly different hourglass shape that is considered the most evenly proportioned of all plus size figure shapes, as it has well-developed shoulders and gentle curves that are in harmonious scale with the rest of the body. It is full and rounded in the bust and hip areas, but appears proportionally smaller around the waist. Just like the average hourglass, the fuller figured hourglass has bust and hip circumferences that are almost equal in width and in most cases the length of the legs equals the length of the torso, and well-proportioned arms (Zangrillo, 1990:5; Rasband, 1994:13; Rasband & Liechty, 2006:210), as illustrated in **Figure 3.2**.

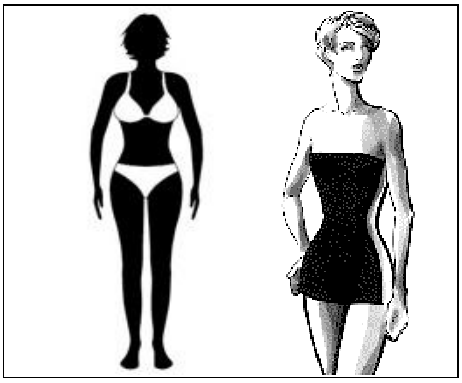


FIGURE 3.2: HOURGLASS FIGURE SHAPE (Source: Liddelow, 2011)

3.4.3 TRIANGULAR FIGURE SHAPE

The triangular shaped figure appears narrower above the waist, i.e. shoulders and bust and widens below the waist, from the abdomen to the lower body (hips, buttocks and hips). The lower body measures slightly more than the waist circumference, which shows an imbalance between the top and the bottom torsos. The figure’s wide hips give an illusion of a smaller waistline and shoulders that are sometimes sloped make the top appear even narrower. Many triangular figures have rounded hips, smaller full cup breasts, full rounded upper arms and legs tapering from the knee to ankle, and also at the arms from elbow to wrist. A substantial number of triangular shaped women have smaller shoulders and bust, with hips or thighs that seem to curve out abruptly below the smaller waist (Rasband & Liechty, 2006:24), as shown in **Figure 3.3**. Weight gain on a triangular figure accumulates on the lower torso first; even with weight gain, the feminine shape of a smaller bust, accentuated waist and full hips are still well defined (Zangrillo, 1990:5; Rasband, 1994:13; Spillane, 1995:33; Rasband & Liechty, 2006:24).

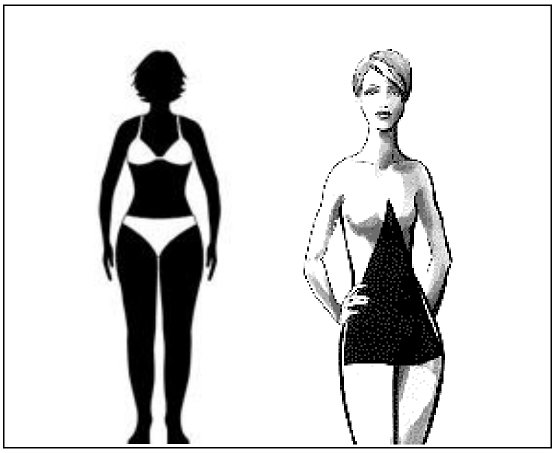


FIGURE 3.3: TRIANGULAR FIGURE SHAPE (Source: Liddelow, 2011)

3.4.4 Rectangular shaped figure

A rectangular figure is characterised by a thick, short, wide torso, wide hips, with no visible waistline indentation and usually long legs. This figure appears to be nearly the same width at shoulders, waist and hips. This is often due to the figure having a broad rib cage and possibly a short waist that is not noticeably indented at the sides and appears proportionately wider than the hips. The bust size may be smaller or flat, with broad shoulders and big upper arms that taper to thick lower arms (**Figure 3.4**). The rectangular figure is common to women who are overweight as well as women who have large and tall frames. A slimmer variation of the rectangular figure is the tubular figure. It has a similar shape as the rectangular figure except that it is thinner with comparatively narrow shoulders, hips, smaller bust, waist, and buttocks. The arms and legs of a tubular figure are relatively thin due to little flesh covering the bones and the below average body weight (**Figure 3.4**). Weight gain on a tubular figure is likely to result in a different figure shape than the rectangular shape. Extra weight for the rectangular figure often accumulates in the midriff area (Zangrillo, 1990:5; Rasband, 1994:13; Spillane, 1995:29-30; Rasband & Liechty, 2006:25).

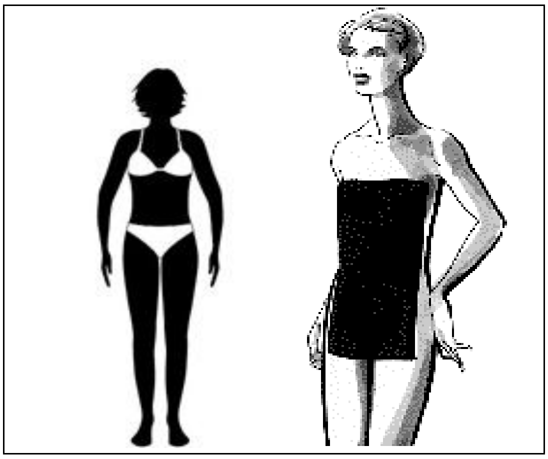


FIGURE 3.4: RECTANGULAR FIGURE SHAPE (Source: Liddelow, 2011)

3.4.5 Inverted triangular shaped figure

An inverted triangular figure is the opposite of the triangular figure in that it has broad straight shoulders, a full bust line and a narrow waist, with even narrower hips. This figure shows an imbalance as the shoulder area is comparatively wider than the hip area, with a bust size that ranges from medium to large. It has a normal hip curve with straight lower hips and thighs. The buttocks are often flatter and the bust circumference is slightly larger than the hip circumference (**Figure 3.5**). An inverted triangular shaped figure accumulates weight around shoulders, upper back, bust, and slightly at the upper hip (Zangrillo, 1990:5; Rasband, 1994:12; Spillane, 1995:27; Rasband & Liechty, 2006:24-25).

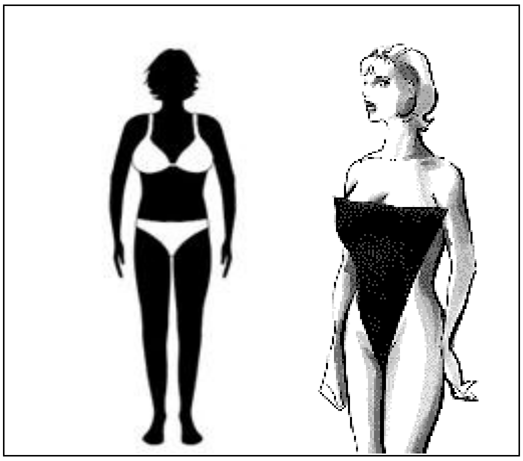


FIGURE 3.5: INVERTED TRIANGULAR FIGURE SHAPE (Source: Liddelow, 2011)

3.4.6 Oval/Rounded (apple) body shape

This figure is referred to as an oval, round or apple shape because all the body areas are fully round. The weight of this figure is above average and the upper back and upper arms are larger and round. The bust, stomach, waist, abdomen, buttocks, hips and upper legs are also round and large. An oval/round body shape has a fuller midsection. This body shape has a tendency to gain weight around the stomach, back and upper body, with an undefined waistline that is the widest part of the body (**Figure 3.6**). The oval/round figure also has a full, shorter neck and a full face, with somewhat flat buttocks and slender legs. When an oval/round figure shaped woman loses weight, the body shape may look like any of the other shapes discussed above (Rasband & Liechty, 2006:25-26).

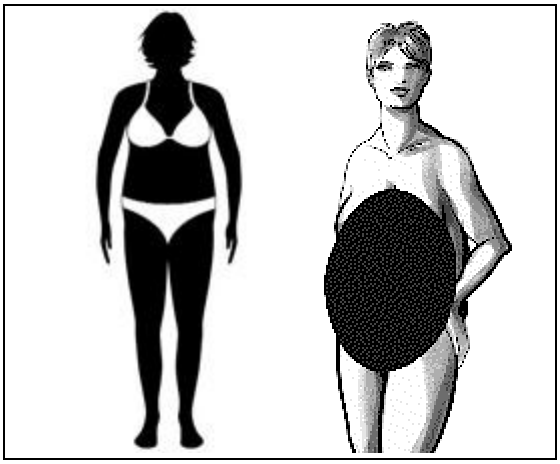


FIGURE 3.6: OVAL/ROUND/APPLE BODY SHAPE (Source: Liddelow, 2011)

3.4.7 Diamond body shape

A diamond body shape has narrow hips and shoulders and a full midsection, i.e. stomach, waist and abdomen. The midriff and upper hips are not narrowing towards the waist, but they appear to expand outward at the waist. The bust is usually smaller, with a high hip curve and straight inwardly tapered side thighs. The buttocks, hips and legs are proportionately smaller than the midsection. This body shape has weight concentrated around midsection, i.e. stomach, waist, back, abdomen, hips and buttocks, as shown in **Figure 3.7**; these are also the first areas of the body to gain weight. The circumference of the midsection measures larger than the bust and hips (Rasband & Liechty, 2006:25).

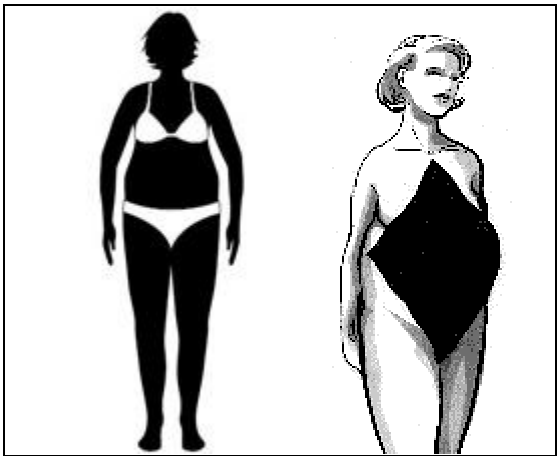


FIGURE 3.7: DIAMOND BODY SHAPE (Source: Liddelow, 2011)

3.5 FIT PROBLEMS ASSOCIATED WITH DIFFERENT BODY SHAPE CHARACTERISTICS

Apparel fit problems common among female consumers are due to the numerous body variations of the female folk and the use of the ideal figure in the apparel industry to design and manufacture RTW apparel. The body shape characteristics prevalent in a target population need to be identified to help ascertain how the body shapes and sizes differ from the ideal figure, and also to determine how these differences impact on apparel fit. As mentioned earlier, figure shapes that differ in shape and size from the ideal figure are likely to experience fit problems. Studying the body shape variations within a population is regarded as one possible way of addressing consumers' apparel fit problems. Body shapes vary from small to large, from short to tall and also in body shape (Brown, 1992; 18). Bougourd (2007:125) also confirms that diversity of figure shapes aggravate apparel fit problems. These variations could be observed within one or between different ethnic groups. Therefore, when constructing RTW apparel, the main focus should be directed at body shape differences within the target population in order to satisfy all consumers' apparel fit needs.

Manufacturers aiming at multi-cultural consumers like the ethnically diverse South African population, need to identify and define prevalent body sizes and shapes. This will help bring an understanding of how the consumers differ in body size and shape within the different ethnic groups as well as from the ideal figure. It will also help determine whether the use of standard apparel would give satisfactory fit across all the ethnic groups. Furthermore, clothing manufacturers also need to ascertain whether the differences in body shape and size are significant among women of different ethnic groups. They also need to determine whether RTW apparel designed to fit one ethnic group would also fit the other ethnic groups, especially if the ethnic groups have body shapes and sizes that significantly differ from the ideal figure. If the differences in figure variations are significant, the standard apparel will not give satisfactory fit.

To achieve satisfactory fit each figure shape will need a base pattern that is similar in shape. Furthermore, designers need to understand the physical characteristics of each body shape in order to combine the elements of design to produce garments that complement each figure's special qualities, camouflage figure flaws and consequently satisfy consumers' fit expectations. Although, according to Shin and Istook (2007), it would be a challenge for apparel manufacturers to set size ranges and grading rules that would provide apparel with satisfactory fit for every figure in the population, it is still imperative that efforts be made to establish size standards that will accommodate ethnic diversity in terms of variation in body shapes and proportions. Otherwise, consumers of different body shapes are likely to experience fit problems and to be dissatisfied with the fit of standard apparel. Below are different fit problems associated with the different figure shape characteristics. The discussion is based on fit problems predicted for each figure shape, emanating from their differences in body shape characteristics from the ideal figure used as a design base.

3.5.1 Fit problems associated with an hourglass figure shape

Fit problems experienced by the typical hourglass figure include too much garment width resulting in loose fit around the smaller waist, and opening edges of centre front closures overlapping more than necessary. Garments hang loose at the waist or drop down to rest on the larger hips. Due to the hips and bust being larger than in an average figure, vertical ripples may occur at the upper hip, and horizontal wrinkles may form between bust tips (Li *et al*., 2003; Pisut & Connell, 2007). As a result buttoned centre front closures may gap between buttons due to insufficient fabric to accommodate the fuller hips and bust (Spillane, 1995:33-36). Diagonal wrinkles may also form between the armhole and bust tips. Side seams may pull forward due to the fuller bust, thus positioning the underarm dart near or over the bust tip. Hemlines also tend to pull up at the front due to the fuller bust (Rasband & Liechty, 2006:198, 210, 288, 314) as illustrated in **Figure 3.8.**

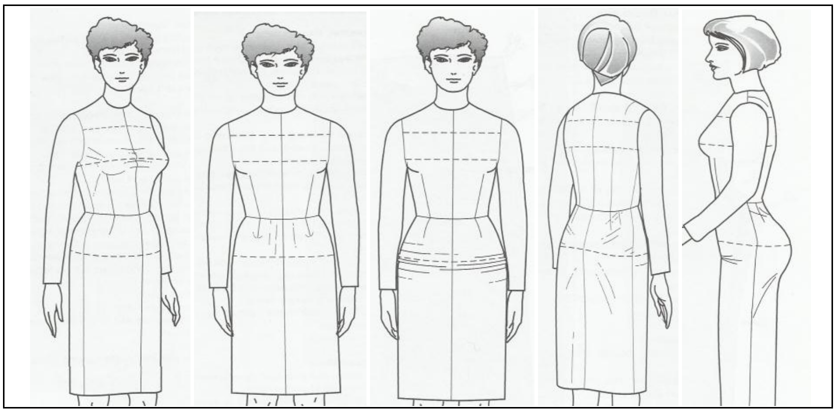


FIGURE 3.8: FIT PROBLEMS ASSOCIATED WITH AN HOURGLASS SHAPE (Source Rasband & Liechty, 2006:198, 210, 288, 314)

3.5.2 Fit problems associated with a triangular figure shape

The triangular shape is characterised by a smaller upper body (bust) than an average figure. They have a small to average stomach, waist and abdomen that are widening below the waist, which also appears smaller in relation to the large hips (Rasband 1994:118). Triangular shapes have slightly larger midriffs than hourglass shapes, yet smaller than rectangular shapes. Fit challenges associated with the triangular figure shape include excessive fabric width across the smaller chest, bust and upper back and narrow shoulders, resulting in loose fitting garments at these body parts (Li *et al*., 2003; Alexander *et al*., 2005; Pisut & Connell, 2007). Loose vertical ripples may form at the back next to the armhole seam and vertical wrinkles across or at the sides of the bust due to the smaller bust. The waistline or hemline may sag at the front due to a flat smaller bust, stomach and waist. According to literature (Rasband, 1994:118; Rasband & Liechty 2006:296), triangular shapes have average to larger abdomens than an ideal figure, as their body tapers from the bust and widens towards the hips. Due to large hips, apparel selected using the hip measurements may fit loosely at the waist and abdomen. Characteristics of triangular shapes include wider lower bodies, and associated fit problems include a skirt hemline that may be pulled up at the back due to larger buttocks. Waistbands of pants may be pulled down by the large buttocks and on the back leg pants, and diagonal wrinkles may be angled towards the crotch. Apparel tightness may also be experienced around the widest part of the hips due to insufficient fabric to accommodate the hips, and tight horizontal ripples may form at the hip area on skirts (Rasband, 1994:68; Li *et al*., 2003; Alexander *et al*., 2005; Rasband & Liechty, 2006:190, 202, 300, 314; Pisut & Connell, 2007). Rasband and Liechty (2006:340) and Shin and Istook (2007) records that triangular shapes have weight concentrated at the lower bodies including the thighs. Expected fit problems include apparel tightness at the thighs forming horizontal ripples below the hipline. In pants the ripples may spread out from the crotch towards the outside thighs. Pants creases may pull outward at the upper thighs and fabric may “cup” under the thighs and buttocks (**Figure 3.9**).

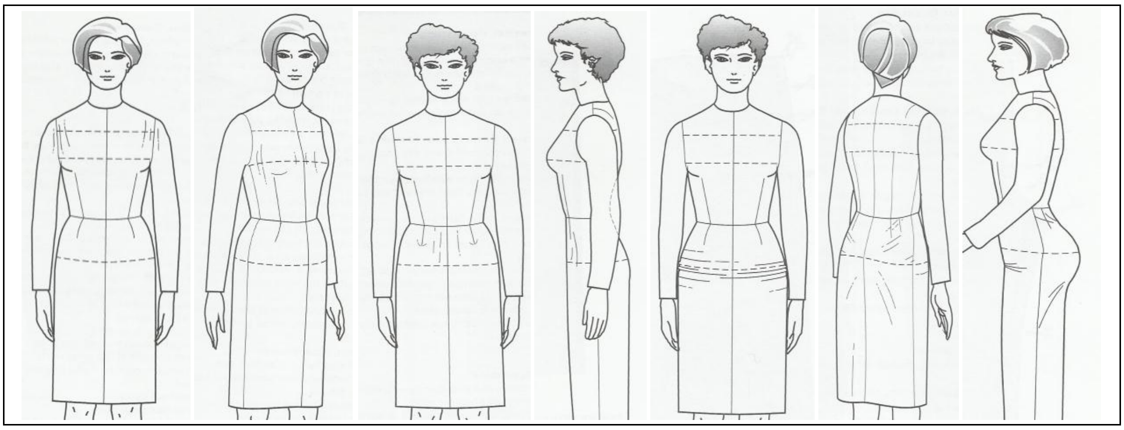


FIGURE 3.9: FIT PROBLEMS ASSOCIATED WITH A TRIANGULAR SHAPE (Source Rasband & Liechty, 2006: 190, 202, 300, 314)

3.5.3 Fit problems associated with an inverted triangular shape

The inverted triangular shape is characterised by narrow hips, a waist wider than the hips, and shoulders and bust even wider than the waistline. Common fit problems associated with this body shape include: tightness around the shoulder blades and bust area, resulting in gaping buttoned centre front and centre back closures. Wrinkles may form between the bust tips and diagonal wrinkles between the armhole and bust tips. Bodice side seams tend to pull forward due to the fuller bust, thus positioning the underarm dart near or over the bust tip. The length of upper garments such as blouses may be shortened at the waist, and the hemline may be pulled up at the front due to the fuller bust (Rasband, 1994:95). As this figure is wider at the top and narrows towards the lower body, it is characterised by narrow hips and flat buttocks, resulting in excess fabric and formation of horizontal ripples at these body parts. Pants may hang too loose and low on the crotch, garments may hang loose in the back, and the skirt hemline may sag at centre back due to flat buttocks. Large upper arms are also a common characteristic of inverted triangular figures, resulting in apparel tightness around the upper arm and horizontal ripples forming, causing sleeves to appear shorter (Rasband, 1994:132; Rasband & Liechty, 2006:190, 194, 202, 228, 292, 219), as illustrated in **Figure 3:10**.

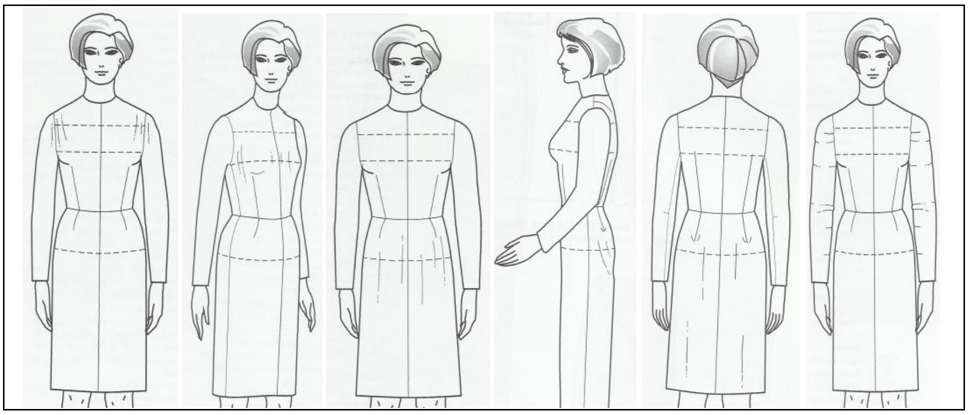


FIGURE 3.10: FIT PROBLEMS ASSOCIATED WITH AN INVERTED TRIANGULAR SHAPE (Source Rasband & Liechty, 2006: 190, 194, 202, 228, 292, 219)

3.5.4 Fit problems associated with rectangular figure shapes

The rectangular figure shape has a larger body than average, which is almost equal from the shoulders to the hips with little or no indentation at the waist and a larger prominent midsection, i.e. stomach, waist and abdomen. Fit problems associated with this figure shape include tightness around almost the entire body, i.e. shoulders, bust, stomach, waist, abdomen, hips and buttocks (**Figure 3.11**), resulting in gaping of fastener edges at centre front, tight waistbands and waist seam lines that may cut uncomfortably into the body at the waist. In skirts, horizontal folds may form around the waist as fabric rolls up towards smaller areas, so that skirts appear shorter. In pants, horizontal folds may be smaller or even fail to form as fabric binds against the crotch (Rasband, 1994:95; Li *et al.,* 2003; Alexander *et al*., 2005; Rasband & Liechty, 2006:186, 194, 288, 296; Pisut & Connell, 2007) (**Figure 3.11**).

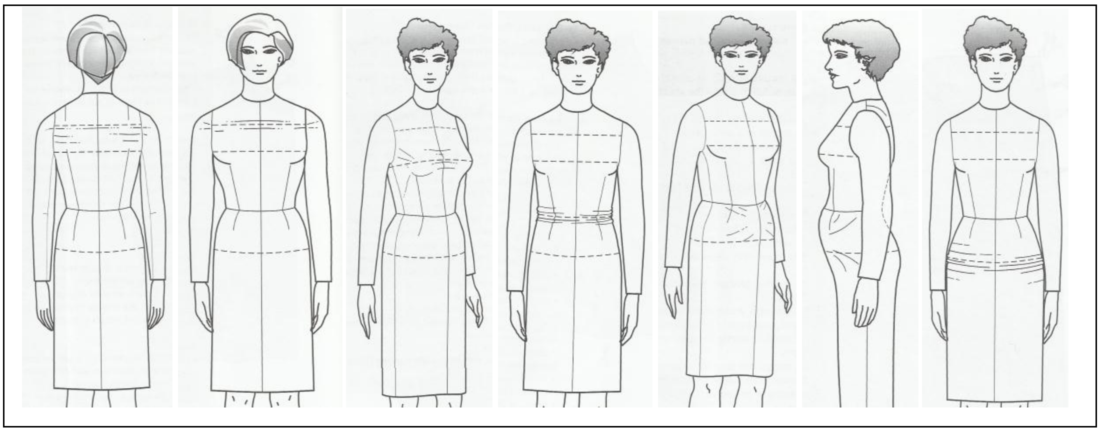


FIGURE 3.11: FIT PROBLEMS ASSOCIATED WITH A RECTANGULAR SHAPE (Source Rasband & Liechty, 2006: 186, 194, 288, 296)

3.5.5 Fit problems associated with the oval/round/apple figure shapes

The oval/round/apple shape is characterised by bust, stomach, waist, abdomen, buttocks, hips and upper legs that are round and larger than those of an ideal figure. Therefore, fit problems associated with the oval/round or apple shape include: not enough fabric width to fit the larger bust, resulting in tight apparel fit around the bust. Horizontal wrinkles may form between the bust tips and gaping of apparel with centre front closures like buttons. Diagonal wrinkles may form between the armhole and bust tips. Due to the fuller bust, the bodice side seams may pull forward, thus positioning the underarm dart near or over the bust tip. The length of upper garments may be pulled up at the front due to the fuller body (Rasband & Liechty, 2006:186, 194, 206, 288, 304, 314), as illustrated in **Figure 3.12**.

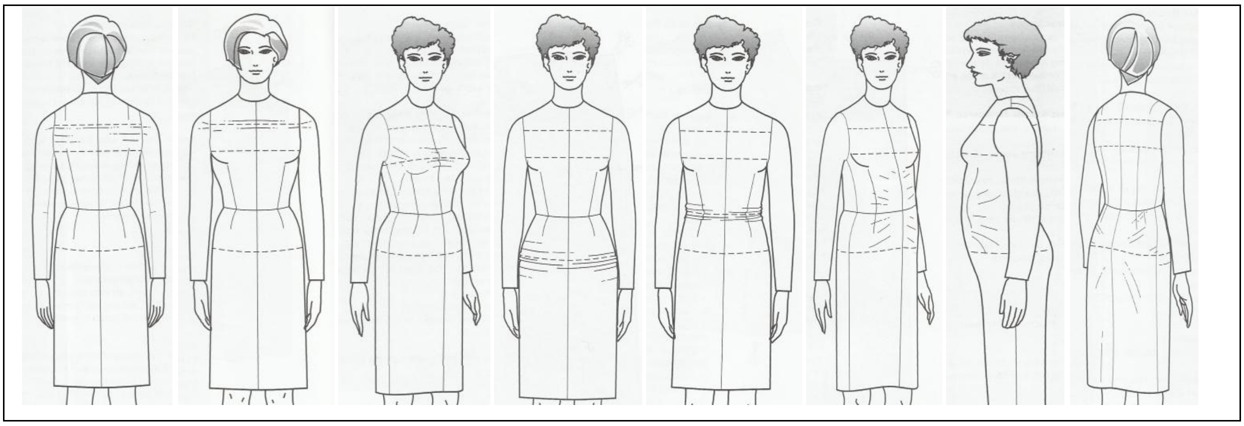


FIGURE 3.12: FIT PROBLEMS ASSOCIATED WITH AN OVAL/ROUND/APPLE SHAPE (Source Rasband & Liechty, 2006: 186, 194, 206, 288, 304, 314)

The oval/round/apple body shape also has a stomach and waist larger than an ideal figure, and expected fit problems include: not enough fabric width at the stomach, waist and abdomen, resulting in tight and gaping apparel. Waistbands may cut uncomfortably into the body, and tight skirts may form horizontal folds around the waist; as a result, skirts may appear too short. In pants, smaller horizontal folds may form or fail to form due to fabric that binds against the crotch. The larger abdomen may also result in side seams that pull forward between the hip and the waist, or tight diagonal ripples that are angled towards the stomach may form (**Figure 3.12**). Fitted skirts and pants may "cup" under the abdomen, exposing the curvature, skirt hemlines may be pulled up at the centre front due to the fuller abdomen. In pants the crotch seam may be pulled up and vertical wrinkles often form between the crotch and the abdomen as fabric is pulled uncomfortably tight.

Due to the larger and round hips, the oval/round figure is likely to experience apparel tightness at hips, resulting in tight horizontal ripples. In pants, horizontal ripples can form around the hips at the side as fabric is held in place at the crotch front and back (Rasband & Liechty, 2006:206, 288). The large and prominent buttocks of an oval/round body shape result in tight apparel as there is usually not enough length, width and curved shaping to fit attractively and comfortably. Apparel tightness results where strained fabric pulls tight across the buttocks. Side seams may bow backwards at lower hip level, the skirt hemline may be pulled up at the back, causing the hemline to poke out at the centre. Strained fabric "cups" under the buttocks, resulting in tight diagonal ripples angled towards the buttocks curve (**Figure 3.12**). In pants the waistband may be pulled down in the back and in the back pants leg, diagonal wrinkles may be angled towards the crotch (Rasband & Liechty, 2006:314).

3.5.6 Fit problems associated with the diamond figure shapes

The diamond body shape is characterised by narrow shoulders, smaller bust, hips and buttocks and a wider midsection (stomach and waist); therefore, fit problems associated with this body shape are: loose apparel fit resulting from too much fabric across the narrow shoulders, forming loose vertical wrinkles or ripples at the sides of the narrow chest and on the sleeve cap. Armhole seam lines may fall off the curved end of the shoulder. There could also be loose apparel fit experienced at the smaller bust, causing loose vertical wrinkles or ripples across or at the sides of the bust. The small bust may also result in excess apparel length causing loose horizontal folds underneath the bust and apparel waistline and hemline sagging at the front. At the waist similar fit problems as the oval/round figure shape may be experienced by the diamond figure shape; they share the characteristic of a larger waist than an average figure. At the narrow hips and smaller bust, the diamond body shape experiences similar fit problems as discussed under inverted triangle (Rasband & Liechty, 2006: 174, 202, 206, 292, 296) (**Figure 3.13**).

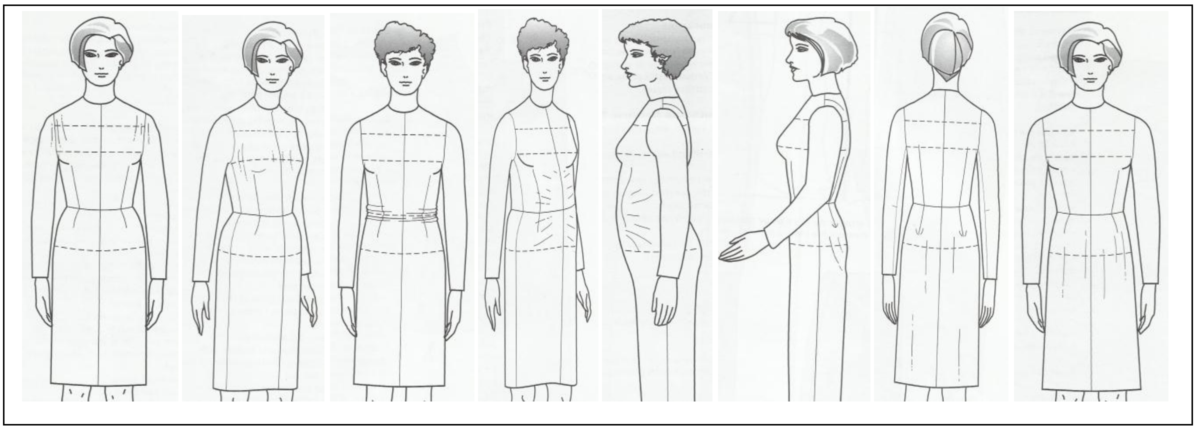
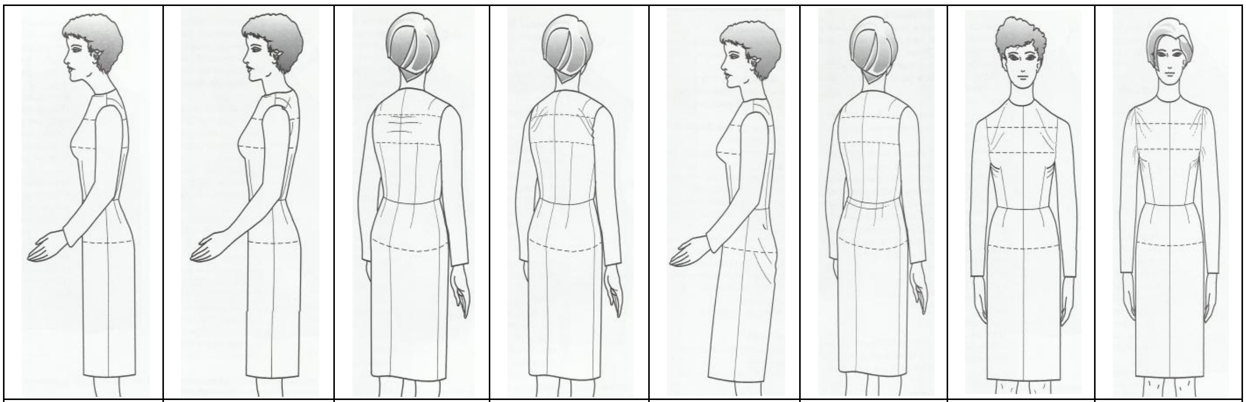


FIGURE 3.13: FIT PROBLEMS ASSOCIATED WITH A DIAMOND SHAPE (Source Rasband & Liechty, 2006: 174, 202, 206, 292, 296)

3.6 FIT PROBLEMS ASSOCIATED WITH POSTURE VARIATIONS

In addition to the fit problems associated with the different figure shape characteristics discussed above, there are fit problems that may occur as a result of other general figure variations that usually occur in combination with some of the body shapes (Rasband, 1994:16; Kwong, 2004:197). The different body postures include forward neck, dowager hump, sloped shoulders, round upper back, overly erect, sway back and sway front postures. Slumped, slouched, rounded and swayed postures cause shoulders to slope, breasts to sag, stomach and buttocks to protrude, and subsequently a number of fit problems may result. Poor posture may cause even an ideal figure to appear unbalanced and out of proportion, whereas a correct posture gives a balanced alignment of the body (Rasband, 1994:16).

Forward neck posture is when the neck is bent forward more than in an ideal figure. There is a sharp curve or angle where the neck joins the chest, thus resulting in a longer upper back area. This posture variation may result in circular wrinkles forming around the back neck base, sagging fabric at the neck front and tight fit at the back. High necklines may also pull forward at the neck (Rasband, 1994:62). A dowager hump is a posture where the upper back at the neck curves outward more than in an average figure. It occurs in combination with a forward head and neck and possibly a shallow chest. This is a posture that is common among older adults (Goldsberry *et al*., 1996b). Fit problems resulting from this posture include short apparel at the back and garment tightness across the upper back. The waistline may be pulled up at the centre back and circular wrinkles may form around the front neckline and horizontal ripples at the back armholes. Clothes may also appear longer at the front **(Figure 3.14).**



Forward head	Dowager curve	Erect upper back	Rounded upper back	Sway front	Sway back	Sloped Shoulders	Squared Shoulders

FIGURE 3.14: FIT PROBLEMS ASSOCIATED WITH POSTURE VARIATIONS (Source Rasband & Liechty, 2006: 174, 202, 206, 292, 296)

The sloped shoulder posture commonly occurs in combination with forward shoulders due to collar bones that are slanting more downwards than in an average figure, thus decreasing the distance between the waist and underarm. As the shoulder joint curves forward more than average, the chest is shortened and narrowed, while the upper back is longer and appears broader. The sloped shoulders cause too much fabric length at the underarm due to a decreased distance between the waist and underarm and too much fabric length at the front, caused by the shortened chest. Diagonal wrinkles may form at shoulder front due to pulling of the garment, the upper sleeve cap may have tight wrinkles coming from the front to the back as back sleeve cap has excess loose fabric. As the fabric sags, diagonal wrinkles may form between the neck and underarm. Loose sagging folds may also appear at the underarm (Rasband & Liechty, 2006:130) (**Figure 3.14**). A rounded upper back posture has the upper back curving more outward than in an average figure, resulting in a lengthened distance between the neck and midriff. A rounded upper back often occurs in combination with rounded shoulders and a shallow chest, thus resulting in tightness of fabric at the upper back, diagonal wrinkles forming between the neck and armhole, and the curved upper back causing fabric to pull at the waistline at the centre back due to insufficient length (Rasband, 1994:13; Rasband & Liechty, 2006:154), as shown in **Figure 3.14**.

An overly erect upper back posture has the entire upper back curving less than in an ideal figure and it usually occurs in combination with square shoulders and a prominent bust. As a result, there is too much fabric length and shaping at the upper back area, causing garments to sag at the waistline at the centre back and horizontal ripples to form across the upper back. An overly erect upper back posture also results in insufficient fabric length at the underarm and fabric to pull tightly, thus forming wrinkles between the bust and shoulder blades that are angled towards the shoulders. Sleeves may appear shorter due to the pulling caused by squared shoulders (Rasband & Liechty, 2006:122) (**Figure 3.14**). The sway back posture has the top of the pelvis tilting forward, lifting buttocks up and outward, thus causing the buttocks to protrude more than average and the groin area at the front becoming more indented than average. The distance between the waist and buttocks decreases, thus increasing the length between the buttocks and crotch. This results in too much fabric length between buttocks and waist causing folds to form below the waist, as illustrated in **Figure 3.14**. Skirt hemlines may pull up at the back and in pants horizontal folds may form, causing fabric to bind against the crotch and to pull tightly under the buttocks (Rasband, 1994:88, 122).

A sway front posture shows opposite characteristics to the sway back posture and usually occurs in combination with flat buttocks. It is as a result of a pelvis that tilts backwards causing the buttocks to protrude less than in an average figure. The waist appears to indent in front more than average. This then result in excess fabric in skirt backs which causes the formation of diagonal ripples as fabric sags across the buttocks. Skirt hemlines also droop against the legs and may round out at the front, and side seams may slant forward (Rasband, 1994:122) (**Figure 3.14**). Different body postures impact on apparel fit and they are therefore another area that requires attention during apparel manufacturing. Identifying the main posture variation within target populations may help apparel manufacturers to accommodate these variations during pattern making and design appropriate apparel styles for the different body postures. This may minimise the apparel fit problems associated with the different postures.

3.7 APPAREL STYLES AND DESIGNS SUITABLE FOR DIFFERENT FIGURE SHAPES

As mentioned earlier, there are different body shapes within target populations, requiring different apparel styles and designs to fit and flatter each body shape. When body shapes of the target population differ from the ideal figure used by the apparel industry as a design base, fit problems are to be expected at the different body parts. When consumers recognise and understand their overall body contours and figure shapes, it is easier for them to understand how their bodies compare to the ideal figure. It also gives consumers an objective guide for selecting clothing styles that will make visual sense and flatter their figure. Women with the same figure shapes regardless of height and size are flattered by similar styles of clothing. Furthermore, understanding one's figure shape and how it compares to the ideal figure alerts manufacturers on how to adjust basic patterns on areas that are likely to require attention and alterations in order to achieve a satisfactory fit (Rasband, 1994:13). This study focuses on the young African and Caucasian consumer segment, especially as to how they differ from the ideal figure for, like all other consumers, they require suitable apparel designs and styles for their different body shapes.

3.7.1 Apparel styles and designs suitable for the hourglass shaped figure

The main aim when selecting apparel for an hourglass figure should be to visually accentuate the figure by reducing the difference between the bust, waist and hip. This can be achieved by choosing loose fitting apparel at the bust, waist and hip and by filling up slightly at the waist area, thus balancing the upper and lower torsos (Rasband, 1994:23; Rasband & Liechty, 2006:213). Suitable styles for an hourglass figure include jackets that cut below the fuller hips. Full-length and pleated skirts are also a better choice as they draw attention away from the less flattering areas such as the hips, whereas an A-line skirt draws attention to the small waist and exaggerate the hip area and should rather be avoided. Suitable fabrics include soft flowy fabrics that drape over the wide areas of the body, thereby disguising their size (Spillane, 1995:33-35; Rasband & Liechty, 2006:48-49, 197, 291).

3.7.2 Apparel styles and designs suitable for the triangular shaped figure

Flattering apparel styles and designs for a triangular figure include those with extended shoulders, shoulder pads and fuller sleeves, to balance the lower and upper torsos of the triangular figure by filling up the narrow and drooping shoulders and smaller bust. Apparel with wide necklines, open collars and shoulder yokes and those with width and fullness around the waist and bodice create an illusion of a better balanced proportion of the upper torso with the lower torso. To add volume to the smaller upper torso it is further recommended that fitted jackets, waistcoats, or cardigans that cut below the hip area and have details above the waist, help draw attention upwards away from the hips and flatters the triangular figure. Furthermore, Spillane (1995:38-40) recommends that triangular shaped individuals should purchase jackets the next size up to fill up around the small upper torso as their actual size may be smaller at the hip area. Moreover, looser tops always give an illusion of a balanced top. In addition, pants and skirts designed for this figure need to be loose fitting to flow easily and camouflage the wide lower torso, i.e. abdomen, hip, thigh and buttocks. Style lines or details used should draw attention away from the width and weight of the lower torso, for example straight hanging or pleated skirts which are styled to flow easily over the lower torso. On the other hand, even though A-line and flared skirts seem to cover the lower torso, their shape and fullness may exaggerate the wide hips and as a result draw attention to the small waistline, and should therefore be avoided (Spillane, 1995:38-40; Rasband, 1994:22; Rasband & Liechty, 2006:44, 205).

Softly gathered and slightly full skirts with totally elasticised waistlines are ideal to cover the wide hip area. Straight waistbands would be larger at the waist as one has to get a bigger size skirt to fit the hip area. This then makes elasticised waistlines to be ideal as the excess fabric allows for good fit around a triangular figure. Straight designs should be avoided because if the waistband is tailored in straight designs, it tends to exaggerate the wide hip area (Rasband, 1994:22). Other suitable styles for a triangular figure include centre front vertical lines and closures as they draw attention inwards then up and downwards, thus giving a slimming effect. Neckline details also draw attention upwards towards the face, whereas hemline details draw attention downwards thus creating an illusion of height for short triangular figures (Rasband, 1994:22). A wise selection of colour may also be used to counteract the imbalance in body proportions. It is recommended that medium to dark colours be used for the bottom of a triangular shape to minimise size, and bright colours and fuller textured fabrics be used to draw attention to the smaller upper body and give an illusion of width (Spillane, 1995:38-40).

3.7.3 Apparel styles and designs suitable for the inverted triangular shaped figure

Inverted triangular shaped figures require styles and designs with lines and details that will draw attention inward and down, away from the widest and largest upper torso (shoulders and bust). Styles that add bulk to the already wide shoulders should be avoided. Thinner shoulder pads may be used as they can lift the fabric so that it fits smoothly over a large bust. Furthermore, tops must be loose fitting to camouflage the fuller upper torso, shoulders, bust, back and midriff. Styles with raglan sleeves in a flowing fabric are recommended to minimise the length of shoulders as the fabric drapes over the upper torso (Rasband, 1994:23, 132). Additionally, simple tailored skirts and pants with soft fullness in the form of flares, gathers and pleats around the waist are appropriate as they create an illusion of a balanced proportion for the upper and lower torsos.

This figure shape usually has a shorter torso and a small waist area. Recommended styles to counteract these figure variations include simple loose hanging blouses as opposed to the tucked-in ones; single-breasted jackets are a best choice as they have a more slimming effect than double-breasted styles whose lapels tend to broaden the shoulders and add more to the bust size. Styles that taper to the waistline should be avoided as they exaggerate the slimmer waist and hips. However, to flatter the small hips, styles like straight or wrap skirts with a little easing into the waistband and details on the hemline like kick-pleats or fish-tail are ideal as they balance the upper and lower torsos (Spillane, 1995:27-28). A triangular shaped figure usually has smaller and flatter buttocks than average, resulting in a decreased distance over the buttocks between the waist and crotch at the body centre (Rasband, 1994:23). Suitable styles for these figure variations are simple tailored pants and skirts with long simple tops. Suitable fabric includes soft flowy fabric that drapes over the bust and the whole torso; stiff fabric may over-emphasise the large shoulders and bust. Darker colours will minimise the size of the upper torso and bright colours will give an illusion of width, thus balancing the upper and lower torsos (Rasband & Liechty, 2006:45, 294; Spillane, 1995:28).

3.7.4 Apparel styles and designs suitable for a rectangular shaped

The rectangular figure requires elegant yet uncomplicated designs and easy lines that will camouflage the silhouette. These include very loose fitting or semi-fitted styles that will flow easily over the stomach, waist and abdomen, such as over-blouses, tunic tops, shifts, chemises, and shirt-waist dresses. To create an illusion of an indented waist, a belt with a centre front detail could be worn loosely to draw attention to the centre of the body at the waist. Layered outfits also help camouflage a rectangular silhouette. Jackets, sweaters, vests worn open at the centre front draw attention inward and create slimming vertical lines (Rasband, 1994:23; Rasband & Liechty, 2006:46-47, 209). Styles and designs that must be avoided by a rectangular figure shape include long or short fitted jackets, as they draw attention to the straight figure, but instead, long, lean double-breasted or single-breasted jackets are ideal. Full gathered styles and stiff fabrics must be avoided, and alternatively flowy styles that easily drape over the figure are appropriate for this figure (Spillane, 1995:30-32). The tubular figure is a slimmer variation of the rectangular figure and suitable clothes for this figure shape include designs with slightly curved loose fitting lines to counter the narrowness and bony angles of the thin figure. Suitable skirts are those with soft or moderate fullness. Angular lines at the neck and bodice can be effectively layered to fill out the figure. Angular pleat lines in skirts and pants add silhouette to the otherwise slim figure, and suitable fabrics include moderately bulky to medium weight fabric; however, extremely heavy fabric may overpower the slim figure (Rasband & Liechty, 2006:51, 299).

3.7.5 Apparel styles and designs suitable for an oval/round/apple body shape

Design and fitting ease are essential to allow fabric to flow easily over an oval/round body shape so as to accommodate and camouflage the silhouette. To flatter an oval/round/apple figure straight lines and angles counter the soft roundness of the figure. Appropriate designs for the oval/round body shape are those that lead the attention inward to the centre of the body, like a loose fitting belt. A loose fitting second layer jacket or tunic worn open at the front, in a contrasting colour to the layer underneath creates vertical lines that draw attention inward and up to the centre front for a slimming visual effect. Apparel styles that draw attention outward at the shoulders counterbalance the rounded figure. Styles with controlled fullness at the shoulder or bust area, e.g. yoke with knife and inverted pleats below, are most likely to flow over the round figure. Moderate shoulder pads will also fill out shoulders to better balance the upper arm, bust, midsection and hips. A V-neck opening draws attention up and down, creating a slimming effect. A narrow skirt silhouette and pleat lines create a vertical eye movement, creating an illusion of slimness and height (Rasband & Liechty, 2006:52-53).

3.7.6 Apparel styles and designs suitable for a diamond body shape

Appropriate styles for the diamond shape include most styles discussed under rectangular and triangular shapes that feature added fullness below the bust. A diamond body shape requires styles that feature width and fullness above and below the waist, to balance the width or weight in the mid-body area and create an illusion of wider shoulders and hips. These include: loose fitting styles to flow easily over the midriff, waist, and abdomen, as well as style lines that draw attention away from the middle of the body or skilfully create the illusion of a waistline as in rectangular shapes. Flared tent and caftan dresses fall straight down from the shoulder line and camouflage the whole upper torso. Design lines or details that will draw attention to centre at the waist and up the face. Light- to medium-weight layered looks are recommended. Rectangular shaped tunic length jackets fall smoothly over bust and abdominal areas for a balanced look between the shoulders and hips. Dark-light colour contrast between apparel layers (with centre front opening) draws attention inwards and upwards. A straight skirt that narrows at the hem gives a more flattering overall appearance

3.8 THE ROLE OF BODY SHAPE IN APPAREL FIT PREFERENCE

Garment fit can be classified into closely fitted, fitted, semi-fitted, loosely fitted and very loosely fitted (Keiser & Garner, 2003:317). Consumer fit preferences may vary from a desire to have a garment fit the body closely, thus giving maximum body emphasis, to a desire for loose fit that gives comfort (Pisut & Connell, 2007). Fit preference influences what an individual perceives to be good fit. Fit is therefore a subjective concept as an individual's perception of fit influences the individual's apparel fit preference. Individuals differ in what they describe as good fit and how they like their clothing to fit their bodies. It depends on one's personal preferences, attitudes and desired look (Alexander *et al*., 2005). Comfort and aesthetics are some of the factors that contribute to consumers' clothing and fit preferences. Current fashion trends, cultural influences, age, sex, body shape and lifestyle also influence personal fit preferences. Changes in these elements may result in changes in personal fit preferences too. According to Pisut and Connell (2007), it is difficult to satisfy fit preferences of different consumers using standard sizes due to the diversity in age, ethnicity, body shape and size. Nevertheless, apparel manufacturers need to strive to satisfy as many consumers as possible. This can be achieved by providing several base patterns that represent the most prevalent body shapes within a population.

Consumer preferences for the varied kinds of fit aim at giving them fit satisfaction. Apparel fit satisfaction is the main attribute consumers consider when purchasing apparel products. However, a number of studies indicate that women are often not satisfied with RTW apparel fit (Goldsberry *et al*., 1996b; Desmarteau, 2000; LaBat *et al*., 2007). LaBat *et al*. (2007) evaluated consumer satisfaction with fit, and found that satisfaction or dissatisfaction with apparel fit results when consumers compare their apparel expectations to its performance. If apparel provides good fit and its performance exceeds consumer expectations, apparel fit satisfaction occurs and consequently future purchase is reinforced. If consumer expectations are not exceeded, apparel fit dissatisfaction may result, which may subsequently lead to garments being returned and consumer disloyalty. Other factors contributing to consumers' satisfaction with fit include society's and the fashion industry's perceptions of an ideal and fashionable figure. Society and the fashion industry have an image they perceive to be ideal. Consumers tend to compare their bodies to the perceived ideal fashion image and expect apparel to fit their bodies in a similar way. Failure to attain these fit expectations may result in consumer dissatisfaction with both their bodies as well as with the apparel fit (LaBat & DeLong, 1990). It is worth noting that there are only a few individuals in a target market that match the size and shape of a fashion figure. As a result, there is a substantial number of consumers who may be dissatisfied with RTW apparel fit. However, consumers may use clothing to reduce the difference between an individual's perceived ideal figure and her actual body in an effort to attain an aesthetic ideal (Robinson, 2003).

Individuals with different body sizes and shapes usually have different fit preferences (Alexander *et al*., 2005). The main body shapes adopted in this study, namely: hourglass, triangle, inverted triangle, rectangle and apple body shapes, are named according to their different body shape characteristics. These body shape characteristics are likely to influence apparel fit preferences at the different body parts. Findings of the said study (Alexander *et al*., 2005) reveal that rectangular and hourglass shaped respondents preferred more fitted garments, whereas triangular shaped respondents preferred loose fitted garments especially for their lower torso. Fit preference is also influenced by age. According to a study conducted in the United States, younger fashion conscious women preferred closely fitted apparel. In contrast, mature older women preferred loose fitting apparel since their priority is apparel comfort over fashion image (Goldsberry *et al*., 1996a; 1996b; Keiser & Garner, 2003:84; Devarajan & Istook, 2004). How people perceive their body size and shape influences their choice of clothing style, design, as well as the kind of apparel fit. Experiences of fit problems are also likely to influence apparel fit preferences as consumers who have fit problems on certain body parts usually use loose fitting apparel to camouflage these.

Several studies have found a relationship between body shape and both body part cathexis and apparel fit preference (Chattaraman & Rudd, 2006; Feather *et al*., 1996; LaBat & DeLong, 1990; Plutt, 2011; Robinson, 2003). The same literature further suggests that women with higher body cathexis choose fitted clothing to accentuate their bodies, and women with low body cathexis choose loose fitting apparel to conceal the body parts they are dissatisfied with (Rudd & Lennon, 2000). Various previous researchers studied the influence of body image and body cathexis on fit preferences (Chattaraman, Simmons & Ulrich, 2013; Manuel *et al*., 2010; Pisut & Connell, 2007), but few concentrated on the association between body cathexis and fit problems. The present study investigated the fit preferences of the predominant African and Caucasian body shapes at the selected body parts.

3.9 THE ROLE OF BODY SHAPE IN BODY CATHEXIS

Petrie *et al*. (2002) define body cathexis as individuals' satisfaction with their overall physical characteristics (body size and shape) (Mahoney & Finch, 1976; LaBat & DeLong, 1990). It represents a degree of satisfaction with one's body and appearance. Poor or low body cathexis indicates one's dissatisfaction with one's body or appearance, whereas positive or high body cathexis signifies satisfaction with the same (LaBat & DeLong, 1990). Body cathexis is related to body size as research reveals that consumers with average body sizes are more satisfied with their bodies as well as with apparel fit, than consumers with larger body sizes who exhibit less satisfaction with both their bodies and clothing fit (Yu, 2004:33). This then suggests that satisfaction with one's body may influence one's perception of apparel fit. Dissatisfaction with one's body results when consumers compare their bodies to those of fashion models on promotional magazines and when their bodies differ in size and shape. This is known as negative body cathexis and may subsequently result in consumers' dissatisfaction with fit (Kozar & Damhorst, 2008). Women who view themselves as large show a decreased level of satisfaction with their bodies and lower levels of self-esteem; generally, women wish to be petite and smaller from the waist down.

Moreover, body shape is one of the main determinants of a woman's perception of her physical attractiveness (body cathexis). LaBat and DeLong (1990) also point out that consumers' dissatisfaction with fit results from apparel failure to conform to their bodies and may also be attributed to their dissatisfaction with their body. They also confirm that women are generally dissatisfied with their lower torso and as a result are less satisfied with apparel fit on the lower body. Individuals with a larger lower torso, e.g. hourglass, triangle and oval/round/apple shapes, tend to compare themselves with the slimmer ideal body, resulting in negative body cathexis and subsequently dissatisfaction with RTW apparel fit for the lower torso. In contrast, Chattaraman and Rudd (2006) show that upper body parts usually record higher body cathexis and fit satisfaction.

Alexander *et al*. (2005) observed that consumers' body shapes influence their body cathexis. Different body shapes have different body shape characteristics, which may impact on how they perceive their bodies and consequently may influence their cathexis. The triangle shape is characterised by smaller upper body and larger lower body, the inverted triangle is characterised by larger upper bodies and smaller lower bodies, and the hourglass has fuller bust and hips and a very small waist. The rectangle body shape is almost equal in width from the shoulder to the hips, oval/round/apple bodies are fuller and round especially the middle body parts, and the diamond shape has smaller upper and lower body and larger middle body parts, especially the waist. The same study by Alexander *et al*. (2005) found that the inverted triangle was more satisfied with their (smaller) lower body than the hourglass and triangle, whose lower bodies were larger than in an average figure. The hourglass shape was dissatisfied with their smaller waist and the rectangular shape was dissatisfied with their larger waist (Alexander *et al*., 2005). These findings show a relationship between body shape and body cathexis.

According to Fan (2004:14), clothing may influence how one feels about one's body. The literature reveals that women are more satisfied with their clothed bodies than with their nude bodies and further indicates that women who are dissatisfied with their bodies may use clothing to compensate for their dissatisfaction (Fan, 2004:14; LaBat & DeLong, 1990; Robinson, 2003; Grippo & Hill, 2008). Clothing improves consumers' satisfaction with their bodies by concealing the body areas that deviate from the cultural ideal. Furthermore, clothing may also be used to de-emphasise or minimise the size of areas of the body that record the lowest body cathexis such as bust, waist and hip size. This can be achieved by selecting closely fitted apparel styles for body areas with high body cathexis, and loosely fitted styles for body parts with low body cathexis, and in so doing, the body image is improved and the self-esteem enhanced (Robinson, 2003). Contrast in apparel design may also be used to alter appearance by making one's body part appear larger so that the adjacent one may look smaller. For example, wearing shoulder pads and a pleated skirt makes the waist look smaller. Consumers may also use apparel to draw attention away from body parts they are dissatisfied with, and to attract attention to the ones they are satisfied with (Robinson, 2003).

According to a study conducted by Secord and Jourard (1953), it is evident that body cathexis is positively related to one's body size and shape and also to the culturally perceived ideal shape and size. The literature also records that generally, women view their bodies to be larger than what they actually are, as very few women match the ideal body size and shape (Robinson (2003). Manufacturers (designers and product developers) therefore need to understand the different body shapes and body (part) cathexis of their target market, the fit problems they experience, and the kind of fit they require (Anderson, *et al*., 2001), in order to produce apparel with satisfactory fit.

3.10 CONCLUSION

Following an in-depth literature review on apparel fit perception (fit problems), it could be concluded that the production of well-fitting apparel should begin with accurate and reliable measurement of the population, and classifying the population into body shape categories, as body shape determines how well apparel will fit the wearer. RTW apparel consumer populations consist of varied body shapes, with different body measurements, body shapes and body shape characteristics, and experience different fit problems at these body parts. The presence of different ethnic groups within populations poses more complex sizing challenges than with ethnically homogenous populations, because of the variation in body shapes and proportions (Keiser & Garner: 2003:302). Therefore, manufacturers have a challenge to provide satisfactory fit for all the figure variations. Standard apparel sizes have proved to be the main cause for apparel fit problems as a majority of consumers have figure shapes differing from the ideal figure. The literature also shows that the apparel industry does not cater for figure shape variations. If fit is to be improved, RTW apparel designing and production must be based on the body measurements and the main body shapes prevalent within the population. Failure by the industry to regulate apparel manufacturing practices like the use of different standard figures, the inconsistent fit and fit problems experienced by consumers will persist.

It was also evident that consumers' body shapes also influence body cathexis as literature (Alexander *et al*., 2005) shows that different body shapes exhibit different levels of satisfaction with their different body parts (shape characteristics). Different body shapes also expressed different fit preferences for the different body parts. The literature survey also revealed an inter-relationship between body shape, fit perceptions (fit problems), body cathexis and fit preferences. Therefore, to better serve apparel consumer populations with satisfactory fit, companies need to understand the relationship between these factors. The next chapter (**Chapter 4**) outlines procedures followed in addressing the objectives and the problem statement presented in the previous chapters.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

In this chapter the research objectives, research design, study population, sampling techniques, data collection procedure, data analysis methods used, as well as ethical consideration in the present study are addressed.

4.2 PRIMARY OBJECTIVES AND SUB-OBJECTIVES

Primary objective 1: To identify and compare body shapes of young African and Caucasian women

Sub-objective 1.1: To identify, categorise and compare body shapes prevalent among African and Caucasian women using measurements and three-dimensional scan images

Sub-objective 1.2: To determine and describe the association between body shapes and ethnicity

Primary objective 2: To describe and compare visual scan images, selected body measurements and measurement ratios of young African and Caucasian women

Sub-objective 2.1: To determine and describe significant differences in selected body measurements and measurement ratios of predominant African and Caucasian body shapes

Primary objective 3: To determine and describe perceived ready-to-wear apparel fit problems encountered by predominant African and Caucasian body shapes on selected body parts

Primary objective 4: To determine and describe body part cathexis of young African and Caucasian women

Primary objective 5: To determine and describe young African and Caucasian women's perceived ideal figure

Primary objective 6: To determine and describe ready-to-wear apparel fit preferences of young African and Caucasian women

4.3 RESEARCH STRATEGY, APPROACH AND DESIGN

This study is a cross-sectional study (Creswell, 2003:15), as data was collected over 4 weeks, in two phases, during one contact session. The scope and objectives of this study dictated that a quantitative exploratory and descriptive research design be utilised (Creswell, 2003:18). Quantitative research begins with an abstract idea, followed by measurement procedures, which result in numerical data that is systematically analysed and presented using computational methods (Creswell, 2003:18).

In quantitative research, observation is conducted and numerical data is collected using predetermined instruments (Creswell, 2003:18). This study employed 3-D body scanning technology to obtain virtual images of 234 young (109) African and (125) Caucasian female apparel consumers, from whom selected anthropometric data was extracted (Simmons & Istook, 2003).

The exploratory and descriptive aspects of this research respectively brought an understanding and a more intensive examination (Singh, 2007:63) of body shape characteristics, body cathexis, perceived RTW apparel fit problems and fit preferences of young African and Caucasian women. The failure by the apparel industry to classify their target markets into different body shapes is one of the reasons why RTW apparel fit problems are a persistent global challenge and a cause for concern for a majority of female consumers. It is for that reason that descriptive-exploratory research was viewed appropriate for this study.

4.4 SAMPLING PLAN

4.4.1 Unit of analysis

There are about 26.6 million females in South Africa: 79.3% African, 9% Coloured, 8.9% Caucasian, 2.4% Indian, and 0.4% other, dispersed throughout the 9 Provinces (Census, 2011). The African and Caucasian groups are the two main population groups in the Gauteng Province (Census, 2012) where this study was conducted. The subjects in the present study were students from two large Universities (University of Pretoria and Tshwane University of Technology) in Tshwane, a major metropolitan city in South Africa. The Tswana and Sotho are the two main African ethnic groups in Tshwane, and the Caucasian ethnic group was a homogenous group.

The units of analysis in this study were young female apparel consumers of African and Caucasian ethnic origin, aged between 18 and 25 years, who belong to the Echo Boom or Generation Y group. Marshall *et al*. (2004:18) noted that the Generation Y consumer segment spends more than half the allowance received from parents plus money earned from part-time jobs on clothing. Following the 1994 socio-political dispensation, South African households with dual or single parents are becoming smaller, career oriented families with a lot of disposable income. This makes the parents of Generation Y consumers to respond positively to their children's demands for clothing (Keiser & Garner, 2003:39; Marshall *et al*., 2004:18, 21).

The Generation Y or Echo Boom is a racially diverse consumer segment, with a computer and entertainment orientation influencing their apparel shopping behaviour (Frings, 2005:34). They are fashion conscious and therefore seek fashionable apparel that is flattering, thus making them look attractive and enabling them to show off their physical attributes, to satisfy emotional needs and to impress and be accepted by their peers (Frings, 2005:34). They purchase new clothes to feel trendy, and may discard wearable clothes as soon as they are out of fashion. All of these attributes make them a viable RTW apparel market worth exploiting (Frings, 2005:34).

4.4.2 Sampling procedure

Purposive sampling and snowballing techniques were employed to obtain a sub-sample from each ethnic group. A total sample of 234 participants was obtained (109 African and 125 Caucasian women). This sample size was reached based on sample sizes used in previous studies (Connell *et al.,* 2001; Connell *et al*., 2003; Devarajan & Istook, 2004). Furthermore, Mastamet-Mason (2008), with an almost equal sample size, successfully conducted a study and followed similar methodologies in classifying body shapes and investigating apparel fit problems of Kenyan women. Rubin and Babbie (2007:167) describe purposive sampling as the selection of a sample based on the researcher's judgement of units that possess useful qualities for the study, and snowball sampling as a method in which the sampled subjects of the population assist in locating more members who possess similar characteristics. Therefore, the total sample of this study included purposively selected subjects who assisted in identifying other subjects with the same characteristics sought in this study.

4.4.3 Pilot testing

Prior to collecting data, the researcher underwent training on how to operate a [TC]^2 NX-12 Version 7.2 body scanner to extract body measurements and virtual body images. The training took place at the Council for Scientific and Industrial Research (CSIR): Materials Science and Manufacturing Unit in Port Elizabeth. Data collection instruments were pilot tested on a convenience and purposively selected sample of 50 students (25 African and 25 Caucasian) who possessed similar characteristics as the final sample, i.e. they were of African and Caucasian ethnicity, aged between 18 and 25 years, and were enrolled at a University (the Nelson Mandela Metropolitan University (NMMU) in Port Elizabeth). The pilot sample was conveniently selected since NMMU is located next to the CSIR (Port Elizabeth) where the scanner was stationed, which is also where the researcher was trained to operate the scanner. The pilot sample did not form part of the final sample. According to Feather *et al*. (1996) and Ruane (2005:141), a pilot test enhances instrument clarity as it helps detect poor questionnaire items, thus improving the manner in which questions are answered. Experts and lecturers in the Department of Consumer Science: Clothing Management section and statisticians at the University of Pretoria critiqued the questionnaire, after which necessary modifications were effected to ensure language clarity, validity and reliability of the questionnaire. Thereafter, the data collection instruments were used to collect data from the final sample. The instruments were the questionnaire, the 3-D body scanner capturing virtual images from which selected body measurements were extracted, and the Body Shape Assessment Scale.

4.4.4 Subject recruitment

Subject recruitment took place prior to data collection. Participants were recruited by the researcher through emails, campus news and posters around the main campuses and residences of the two Tshwane Universities. The researcher requested voluntary participation from students who possessed the qualities sought in the study. The participants also recruited more subjects by word of mouth through the snowballing technique. The purpose and objectives of the study as well as the data collection procedure were explained to potential participants. They were assured of confidentiality and anonymity of information gathered through body scanning and the questionnaire (Rubin & Babbie, 2007:167). The whole data collection process was explained to the participants and they were also reassured that body scanning was not harmful as it utilised white light (Yu, 2009). Participants were requested to participate in both body scanning and questionnaire completion for complementary and useful data. All the information obtained from one subject, i.e. questionnaire, scan data and body shape assessment scales, had the same code to eliminate chances of data mix up and confusion.

4.5 CHOICE, DESCRIPTION AND APPLICATION OF DATA COLLECTION METHODS

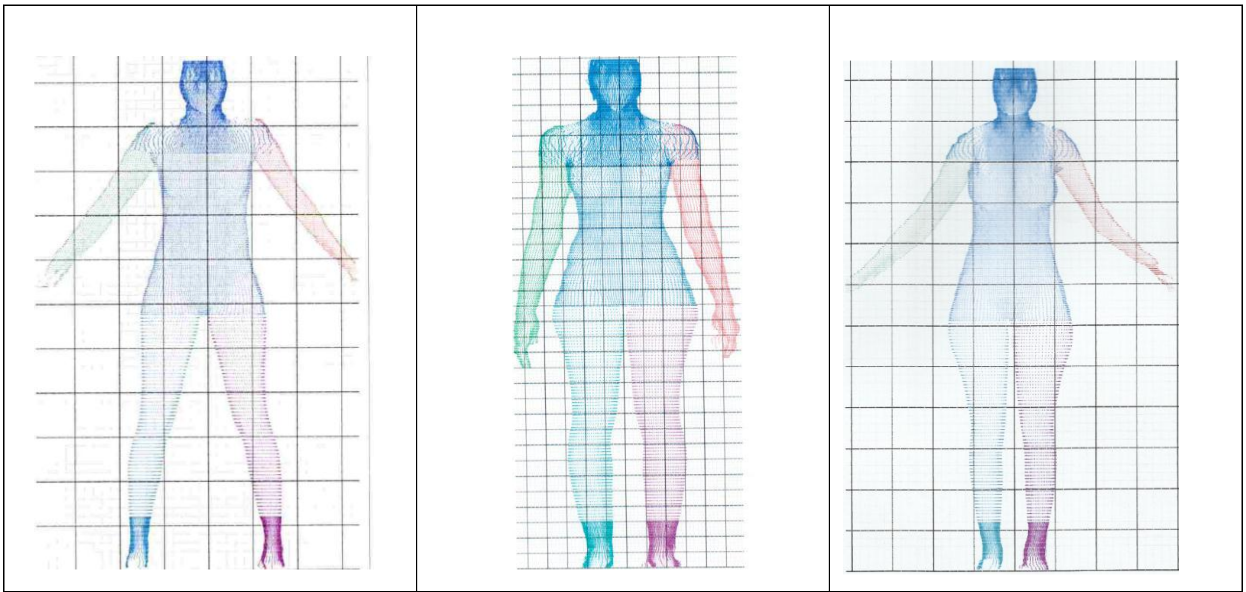
The data collection site was set up at the Consumer Science Department of the University of Pretoria, which was conveniently located for the students and had a security system that safeguarded the body scanner. The NX-12 Version 7.2 3-D body scanner was erected, and the system calibration was tested and verified in readiness for scanning. The systems calibration was also conducted every morning to ensure accurate capturing of virtual images and consequently correct extraction of measurements. The system calibration was done beforehand to minimise contact time with each subject. The scanning facility consisted of a changing cubicle adjacent to the scanning cubicle, next to which were weight and height scales as well as chairs and desks that were used to complete the questionnaires. A dress/body form labelled with body parts was provided to help participants to correctly locate technically unfamiliar body parts, such as the crotch, and to differentiate between stomach, waist and abdomen as well as hip, seat and thigh.

4.5.1 Subject preparation for scanning

Interested participants had to indicate on a scanning schedule: a convenient date and time when they were to be scanned, and their contact cell numbers and/or e-mail addresses through which appointment reminders were sent. Upon arrival, the participants were provided with two pieces of scanning garments based on their body build and RTW apparel size. Subjects of smaller build (size 6-8) were given size Small, average build (size 10-12) were given size Medium, large build (size 14-16) were given size Large, and very large subjects were given Extra Large sizes. The scanning garments were sewn using grey stretchy 95%

cotton and 5% Lycra fabric. For hygienic and ethical reasons, the scanning garments were worn once and then laundered before being used the next day. They were also worn over well-fitting undergarments with good support. The fitted stretchy scanning garments allowed accurate capturing of a smooth silhouette and subsequently extraction of correct measurements. Participants with long hair and braids were advised to fasten their hair up and away from the neck to enhance the quality of scan images and consequently, accurate extraction of measurements. Thereafter, consent forms were signed by participants before the commencement of the data collection process (Creswell, 2003:64).

Subjects were then advised on the data collection procedure and scanning process, specifically the different scanning postures. Participants were told to be relaxed and to breathe normally throughout the scanning duration (Wang *et al*., 2006); also that they had to follow the instructions given by the researcher through audio streams. The first two scan images were taken with the subjects standing in the normal scanning position (**Figure 4.1** Posture A), i.e. upright with the head in the Frankfurt plane position, with long axes of feet 20 cm apart and parallel to each other, and upper arms at about 20^{o} angles with the sides of torsos and forearms hanging vertically; palms had to face backwards (ISO/ DIS20685, 2004). Scan images taken in Posture A (**Figure 4.1)** were used to extract the selected body measurements of all the subjects. This ensured that measurements were extracted uniformly and consistently. Third scans were taken in Posture B (**Figure 4.1**), where subjects stood erect with legs and heels together, arms hanging relaxed on the sides, palms facing backwards (ISO/ DIS20685, 2004). The fourth scan as shown in Posture C (**Figure 4.1**) subjects stood erect with legs and heels together and the arms hanging away from the body as in Posture A (**Figure 4.1**) (ISO/ DIS20685, 2004). The third and fourth scans enabled the expert visual evaluators to assess participants' body shapes with ease, thus allowing accurate verification of body shape assigned from measurements.



POSTURE A	POSTURE B	POSTURE C

FIGURE 4.1: SCANNING POSITIONS

4.5.2 Data collection with [TC]^2 NX-12 version 7.2 3-D body scanner

Participants entered the enclosed dressing room where they removed upper garments and wore scanning garments over their everyday well-fitting/supporting undergarments. Subjects reported loose or tight fitting scanning garments to the researcher. These were exchanged for well-fitting ones, and subjects then entered the private scanning cubicle. A thick black felt curtain was drawn and sealed with Velcro and weighted hems to make sure that no light passed through into the scanning cubicle. According to Lu and Wang (2008), light interferes with the quality of the scan image.

The 3-D body scan operator (the researcher) and pre-recorded instructions guided the participants on the scanning position and process. Participants started the scanning process by pressing a button on the right-handle. The whole body image was captured in approximately 6 seconds and body measurements extracted in about 3 seconds. The unit stopped briefly five to six times to ensure accurate body scanning, bringing the total scan duration to an estimated 54 seconds (Xu *et al*., 2002b; Mbanga, 2009). Subjects were scanned four times with short breaks in between scans, to enable the researcher to assess the quality of scan images before saving them. A total of 22 body measurements (Table 4.1) that are crucial in the classification of body shapes and apparel fit were extracted. These measurements included (4) height, (7) circumferences, (5) width and (6) protrusion measurements. These measurements were automatically extracted based on the [TC]^2

landmarks location outlined in the second column of Table 4.1 (Beazley, 1996; Bougourd, 2004; Yu, 2004:171-172). These landmarks are automatically located by the scanner and they indicate where and how each measurement is extracted by the $[TC]^2$ NX-12 Version 7.2 3-D body scanner.

TABLE 4.1: AUTOMATICALLY EXTRACTED BODY MEASUREMENTS, LOCATING LANDMARKS AND BODY LOCATION (Beazley, 1996; Bougourd, 2004; Yu., 2004:171-172)

	BODY DIMENSIONS	[TC]^2 LOCATION LANDMARKS	BODY MEASUREMENT DESCRIPTION
Circumferential measurements	Bust Full/ Circumference	Vertebral column, lowest part of soft tissue forming the axilla nipples	Bust girth, maximum circumference measured under the shoulder blades, under the armpits across the bust points
	Stomach Full/ Circumference	Vertebral column, lowest part of soft tissue forming the axilla nipples	Stomach girth, maximum horizontal circumference measured below bust above waist
	Waist Full/ Circumference	Vertebral column, small of the back, 4 cm above small of the back, waist level	Waist girth, smallest circumference between small of back and a level 4 cm above small of back
	Abdomen Full/ Circumference	Vertebral column, small of back, maximum frontal prominence below the waist and above upper hip	Abdomen girth, maximum horizontal circumference from the frontal plane measured below waist and above upper hip
	Hips Full/ Circumference	Vertebral column, small of back, prominence of buttocks, crotch	Hip girth, circumference of the fullest side to side measurement between waist and crotch
	Seat Full/ Circumference	Maximum prominence of buttocks, vertebral column, small of the back, 4 cm above small of the back, waist level	Seat girth, circumference of the maximum seat prominence
	Thigh Full/ Circumference	Thigh	Thigh girth, maximum circumference of the thigh measured at level midway between crotch and knee level
Body protrusions	Bust Front/Bust protrusion	Lowest part of the soft tissue forming axilla, breast nipples and centre of scye width	Bust front, distance at bust level from midpoint of the scye width at right underarm, over breast points to the corresponding point at the left
	Stomach Front/ Stomach protrusion	Lowest part of the soft tissue forming axilla, breast nipples	Stomach front, distance at front stomach level from the centre of the right side of the body to the corresponding point at the left
	Waist Front/ Front Waist protrusion	Spinal process at small of the back, 4 cm above small of the back, waist level	Waist front, distance at front waist level between centre of right side body and corresponding point at the left side of body
	Abdomen Front/ Abdomen protrusion	Spinal process at small of the back, 4 cm above small of the back, waist, maximum frontal prominence below the waist and above upper hip	Abdomen front, distance at front abdominal prominence level from centre of the right side of the body to the corresponding point at the left
	Waist Back/ Back Waist curvature	Vertebral column, small of the back, 4 cm above small of the back, waist level	Waist back, distance at back waist level between centre of right side of body and corresponding point at the left side of body
	Seat Back/Seat protrusion	Maximum frontal prominence of buttocks, vertebral column, small of the back, 4 cm above small of the back, waist level	Seat back, distance at maximum back seat prominence between centre of right side body and corresponding point at the left side of body
Height dimensions	Bust Height	Maximum bust projection	Bust height, distance between level of maximum bust point and floor
	Waist Height	Spinal process at small of the back, 4 cm above small of the back, waist level	Waist height, distance between waist level at centre back and floor
	Hips Height	Vertebral column, small of back, maximum frontal prominence of buttocks	Hip height, distance between fullest part of buttocks and floor
	Knee Height	Centre patella with straight knee	Knee height, distance between right front knee level and floor

TABLE 4.1: AUTOMATICALLY EXTRACTED BODY MEASUREMENTS, LOCATING LANDMARKS AND BODY LOCATION (Beazley, 1996; Bougourd, 2004; Yu., 2004:171-172) CONTINUED

	BODY DIMENSIONS	[TC]² LOCATION LANDMARKS	BODY MEASUREMENT DESCRIPTION
Width dimensions	Bust Width	Vertebral column, lowest part of soft tissue forming the axilla nipples	Bust width, calliper or straight horizontal distance measurement from the right side to left side at under bust level
	Stomach Width	Vertebral column, lowest part of soft tissue forming the axilla nipples	Stomach width, calliper or straight horizontal distance from the right side to left side at stomach level
	Waist Width	Vertebral column, small of the back, 4 cm above small of the back, waist level	Waist width, calliper or straight horizontal distance from the right side to left side at waist level
	Abdomen Width	Vertebral column, small of back, maximum frontal_prominence below the waist and above upper hip	Abdomen width, calliper or straight horizontal distance from the right side to left side at abdomen level
	Hip Width	Vertebral column, small of back, maximum frontal prominence of buttocks, crotch	Hip width, calliper measurement from the right side to left side at hip level

Thereafter, scan images showing the front and side view images of participants as shown in **Figure 4.2** were printed for further analysis by expert visual evaluators to confirm body shapes classified from measurements.

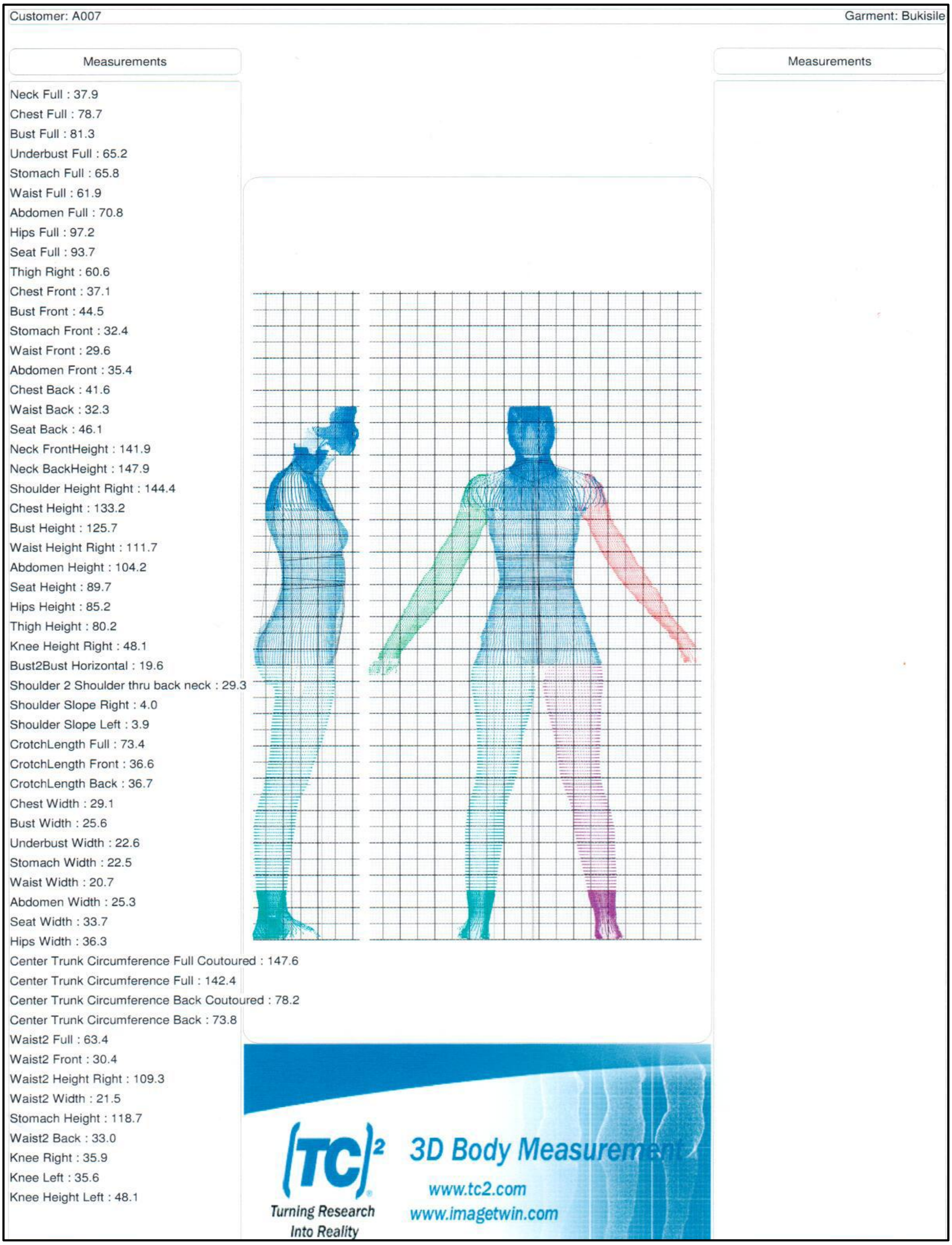


FIGURE 4.2: BODY MEASUREMENTS EXTRACTED FROM 3-D SCAN IMAGES

4.5.3 Data collection using questionnaire

As already mentioned, this study also collected data using a questionnaire. Questions in the questionnaires were formulated based on the objectives of the study. The in-depth literature review helped to identify important concepts on body cathexis, apparel fit problems and apparel fit preferences, thus ensuring theoretical constructs and content validity. Structured closed-ended questions were used, whereby respondents select an answer from a fixed list. Closed-ended questions give more uniform answers that are easy to process (Babbie, 2005:254; Terre Blanch, Durrheim & Painter*,* 2006:486).

The questionnaire consisted of three content sections, Sections A-C (**Addendum 2**). **Section A** consisted of nominal scales on consumer profile. These included: consumer's ethnicity and their perceived ideal body shape. Body weight and total body height were taken separately and entered in allocated spaces under Section A. **Section B** focused on consumer's body part cathexis with selected body parts and was measured using a body cathexis scale that was modified from previous studies (Feather *et al*., 1996; Hwang, 1996; Petrie *et al*., 2002), which adapted it from the original scale by Secord and Jourard (1953). The body cathexis scale used in this study was a self-report instrument that assessed the degree of satisfaction with one's body parts. Participants were asked to rate their level of satisfaction with 7 selected body parts on a 7-point Likert scale, with 1 – extremely dissatisfied to 7 – extremely satisfied. **Section C** covered consumers' perceived RTW apparel fit problems and fit preferences. Participants indicated the occurrence of RTW apparel fit problems at selected body parts on a 5-point Likert scale, ranging from 1 **–** Never (experienced), 2 – Seldom (experienced), 3 – Sometimes (experienced), 4 – Often (experienced), and 5 – Always (experienced). Participants were required to indicate the specific fit problems on a nominal scale of 1 – too tight/too short, 2 – too loose/too long and 3 – No fit problem. They also had to indicate the kind of RTW apparel fit they prefer on the 7 selected body parts on a 5-point nominal scale of 5 – very closely fitted, 4 – fitted, 3 – semi-fitted, 2 – loosely fitted or 1 – very loosely fitted. As a token of appreciation, participants were rewarded with sweets and a printout of their 3-D body scan images and key body dimensions.

4.5.4 Data collection using expert sensory evaluators

Two trained expert sensory evaluators were selected, based on their vast experience of over 10 years in apparel sizing and fit. They were trained on body shape descriptors and how to visually analyse and compare participants' bust, waist and hips to verify the figure shapes assigned, based on the front and side views of 3-D scan images. They used a Body Shape Assessment Scale (**Addendum 3**) that was designed based on body shape descriptors identified, and summarised from literature (Simmons *et al*., 2004a; 2004b; Lee *et al*., 2007; Mastamet-Mason, 2008:151). These descriptors included bust size and position, comparison of upper body to lower body sizes, comparison of size, position and shape of the bust, stomach, waist, abdomen, seat, hip and thigh size, and the shape and extension or depth of the lower backs. Each participant's body shape was assigned after both experts reached a consensus.

4.6 DATA PROCESSING

Data processing includes data cleaning, which involves scrutinising the research instruments to identify and minimise errors, incompleteness, misclassification and gaps in information gathered from respondents (Creswell, 2005:589). Data from all three data collection instruments, namely: scan data, i.e. body measurements and scan images, the questionnaire, and the Body Shape Assessment Scales, were cleaned and recaptured.

4.6.1 Scan data processing

Participants were each assigned a code that was reflected on all three data collection instruments. To ensure accuracy of images, several scan images were captured, and each was assessed for quality before it was saved. Poor quality images were disregarded and subjects were rescanned until good quality images were obtained. The 22 body measurements used in this study were defined using the Measurements Extraction Profile (MEP) $[TC]^2$ NX-16 Version 5 software program, which enabled the researcher to verify whether all measurements were correctly located. Thereafter the measurements were extracted using an automatic data extraction process. To ensure the accuracy of measurements, they were extracted from the best image taken in the normal scanning position (**Figure 4.1:** Posture A). The 22 body measurements were individually assessed to determine whether they were taken at the correct location as guided by $[TC]^2$ locating landmarks in **Table 4.2.** Due to variation in body shape, size, posture and height, it was observed that a number of circumferential measurements were taken at wrong locations and were therefore erroneous. This was commonly observed on fuller figured subjects, as alluded to by Zwane *et al*. (2010) as well as subjects whose hair hung loose, thus obstructing accurate capturing and location of the neck. This then resulted in incorrect measurements being recorded, for example at the bust, stomach, waist, abdomen and hip circumferences of fuller figured participants, and also measurements whose location and extraction depended on a landmark, data points or on another measurement that was wrongly located.

To rectify erroneous measurements the [TC]^2 NX-16 Version 5 software was used. This software allowed manual movement of data points to new locations, as specified in **Table 4.2**. Specifically, the data point modification program allowed repositioning and correction of back, front, left and right data points of the neck, shoulder, bust, waist and crotch of affected images. Thereafter, the measurements' location was assessed before they were extracted again. Subsequently, all measurements required by the current research from all subjects were extracted again and were automatically transferred and saved onto a spread sheet/Excel file. Since measurements were extracted and transferred electronically, human errors common in manual recording were eliminated. Data was re-checked by the researcher to ensure accuracy; thereafter, it was ready for processing.

4.6.2 Processing of questionnaire data

Questionnaires were pre-coded with codes similar to those on the scan data printout. Each questionnaire was edge-coded, i.e. each page of the questionnaire had a right-hand margin marked with spaces corresponding to each variable. The researcher assessed the questionnaire to ensure completeness. This was done to identify errors and gaps or missing data. Participants were urged to correct and complete the questionnaire before leaving the data collection venue. Thereafter, the researcher entered all the answers selected by respondents from the nominal and Likert scales into the right-hand margin. The codes were then captured into a Microsoft Excel file. There were a few coding errors that were as a result of incorrect coding or incorrect reading of codes. These then necessitated code cleaning, i.e. all the codes were checked against the questionnaires to identify any errors. This exercise was repeated until no more errors were detected and thereafter the clean data was ready for analysis.

4.6.3 Processing of expert sensory evaluators' data

The two expert sensory evaluators completed the Body Shape Assessment Scales of all the participants. Similarly, each Body Shape Assessment Scale was pre-coded with a similar code as the scan data and questionnaire. Thereafter, the researcher assessed the scales to ensure that the evaluators had completed all the sections; incomplete scales were returned to the evaluators for correction and completion. The researcher then coded all the assessment scales, i.e. entered answers/codes into the right-hand margin. The codes were captured into a Microsoft Excel file and checked against the assessment scales to confirm and correct any errors. This exercise was repeated until no more errors were detected and the data was clean and ready for analysis.

4.7 OPERATIONALISATION AND DATA ANALYSIS

4.7.1 Operationalisation

The scan and questionnaire data addressed the objectives of the study and the data collected was analysed, as illustrated in **Table 4.2**.

TABLE 4.2: OPERATIONALISATION OF SCAN AND QUESTIONNAIRE DATA

OBJECTIVES	VARIABLES	STATISTICAL METHODS
SCAN DATA ANALYSIS (MEASUREMENTS AND SCAN IMAGE) **Primary objective 1: To identify and compare body shapes of young African and Caucasian women**		
SUB-OBJECTIVES	**INDICATORS**	**STATISTICAL PROCEDURE**
Sub-objective 1.1: To identify, categorise and compare body shapes prevalent among African and Caucasian women using measurements and three-dimensional scan images **Sub-objective 1.2:** To determine and describe the association between body shapes and ethnicity	**Drop values** Hip minus bust Bust minus waist	**Descriptive statistics** Frequency distribution, Mean, Standard Deviation, minimum & maximum of drop values used to classify body shapes Body shapes and visual differences summarised and presented in tables, using frequency distribution, i.e. percentages **Chi-square** To determine the association between body shapes and ethnicity
Primary objective 2: To describe and compare visual scan images, selected body measurements and measurement ratios of African and Caucasian women		
Sub-objective 2.1: To determine and describe significant differences in selected body measurements and measurement ratios of predominant African and Caucasian body shapes	**Body measurements** Circumferences, width, body protrusions, height dimensions, circumferential &height ratios **Body shapes** Triangle, Inverted triangle, Hourglass, Rectangle, Apple	**Descriptive statistics** Measurements and ratios compared, summarised and presented in tables as frequencies and percentages Measurement median, percentile distribution (25% to 75%) minimum & maximum summarised in box plots **Kruskal-Wallis test** To determine significant differences in selected body measurements and ratios of predominant African and Caucasian body shapes
QUESTIONNAIRE DATA **Primary objective 3: To determine and describe perceived ready-to-wear apparel fit problems encountered by predominant African and Caucasian body shapes on selected body parts**		
	INDICATORS	**STATISTICAL PROCEDURE**
	Fit problems categories Tight apparel fit Loose apparel fit No apparel fit problem **Body shapes** Triangle, Inverted triangle, Hourglass Rectangle & Apple	**Descriptive statistics** Frequencies and percentages of fit problems summarised and presented in tables

TABLE 4.2: OPERATIONALISATION OF SCAN AND QUESTIONNAIRE DATA CONTINUED

OBJECTIVES	VARIABLES	STATISTICAL METHODS
Primary objective 4: To determine and describe body part cathexis of young African and Caucasian women		
	Body part cathexis of: Bust, stomach, waist, abdomen, hip, seat and thigh **Body shapes** Triangle, Inverted triangle, Hourglass Rectangle, Apple	**Descriptive statistics** Frequencies and percentages summarising selected body part cathexis, of predominant African and Caucasian body shapes
Primary objective 5: To determine and describe young African and Caucasian women's perceived ideal figure		
	Body shapes Triangle, Inverted triangle, Hourglass Rectangle, Apple	**Descriptive statistics** Frequencies and percentages of perceived ideal fit problems summarised and presented in tables
Primary objective 6: To determine and describe ready-to-wear apparel fit preferences of young African and Caucasian women		
	Body part cathexis of: bust, stomach, waist, abdomen, hip, seat and thigh **Body shapes** Triangle, Inverted triangle, Hourglass Rectangle, Apple	**Descriptive statistics** Frequencies and percentages summarising RTW apparel fit preferences of predominant African and Caucasian body shapes

4.7.2 Data analysis

The 3-D body scanner captured participants' 3-D virtual body images, from which 22 selected body measurements of young African Caucasian women were extracted. The selected body measurements were subjected to statistical processes for classification of participants' bodies into pre-determined body shapes.

4.7.2.1 Body shape classification

There were five body shape classes that were identified (Simmons *et al*., 2004a; 2004b) and adopted in this study, namely hourglass, apple, triangular, inverted triangular and rectangular shapes. Each of these body shapes was assigned defining parameters using Mean ± Standard deviation within the maximum and minimum drop values of key circumferential measurements (Mastamet-Mason, 2008:151), guided by the body shape descriptors outlined in Simmons *et al*. (2004a; 2004b) and Lee *et al*. (2007).

Table 4.3 shows body shape parameters and drop values (differences) of key circumferential measurements, i.e. hip minus bust and bust minus waist, used to classify the body shapes of African and Caucasian women. First to be classified were the triangular and inverted triangular shapes, using drop values hip minus bust. Thereafter, the hourglass, rectangular and apple shapes were classified, using the bust minus waist drop values. After classifying all the participants into the different body shape categories, their 3-D body scan images were subjected to visual analysis by two expert evaluators who used the Body Shape Assessment Scale to verify the body shapes assigned, using drop values. This scale outlines a detailed assessment of participants' bodies, i.e. their bust, waist, stomach, abdomen, hip, seat, thighs, upper and lower body shapes and sizes. This enabled the experts to assess each of the body parts and their part-to-part relationship, and thereafter verify the body shapes assigned from the measurements. A body shape was adopted for each subject once the experts were in agreement on the body shape category.

TABLE 4.3: CLASSIFICATION AND DEFINING PARAMETERS OF AFRICAN AND CAUCASIAN BODY SHAPES

1st STEP: Triangular and Inverted triangular are guided by the principle that a Triangular shape has a bust smaller/narrower than hips, Inverted Triangular has a bust wider/larger than hips. (Once classified, these will no longer be subjected further to bust-waist relationship.)				
Drop values Hip subtract Bust	**Mean**	**SD**	**Minimum**	**Maximum**
	12.6 cm	5.7	0.09 cm	29.8 cm
BODY SHAPE CLASSES	**DEFINING PARAMETERS**			
TRIANGULAR	Mean to Max **12.6 ≤ hip – bust ≤ 29.8**			
INVERTED TRIANGULAR	**hip – bust < 0**			
2nd STEP: Hourglass and Rectangular shapes both have smaller waist than bust, the difference being Hourglass has a higher drop value than Rectangular. Apple shape has fuller/rounder bust, waist and hips, the waist may be slightly wider or almost equal to the bust.				
Drop values Bust subtract Waist	**Mean**	**SD**	**Maximum**	**Minimum**
	18.0 cm	4.1	-3.7 cm	26.6 cm
BODY SHAPE CLASSES	**DEFINING PARAMETERS**			
HOURGLASS	Mean ≤ bust – waist ≤ Max. **18 ≤ bust – waist ≤ 26.6**			
RECTANGULAR	Mean (18 cm) – 3xSD (12.3 cm) < bust – waist < mean **5.6 < bust – waist < 18**			
APPLE	Minimum ≤ bust – waist ≤ Mean (18 cm) – 3xSD (12.3) **-3.7 ≤ bust – waist ≤ 5.6**			

(Adapted from Lee *et al*., 2007; Mastamet-Mason, 2008; 151) Measurements are in cm.

The Chi-square test was used to determine the relationship between body shape prevalence and ethnicity at a 5% level of significance. Furthermore, the Kruskal-Wallis test was used to determine significant differences in selected body measurements and measurement ratios of predominant African and Caucasian body shapes. Body measurements and measurement ratios that recorded significant differences were further subjected to *post-hoc* tests for planned pair-wise comparison to determine significant differences in measurements and ratios of predominant African and Caucasian body shapes. Comparisons of interest in this study were similar African and Caucasian body shapes, e.g. African and Caucasian hourglass shape, African and Caucasian rectangle, African and Caucasian triangle, as well as African and Caucasian triangle, African and Caucasian rectangle, with the Caucasian (Western) hourglass shape that is currently used by the apparel industry.

4.7.2.2 Analysis of Questionnaire data

A questionnaire was used to gather data on the consumers' profiles, which included consumers' ethnicity, weight and height, as well as their perception of an ideal figure shape, their selected body part cathexis, perceived RTW apparel fit problems and fit preferences on selected body parts. The questionnaire data obtained was analysed, compared and summarised, using descriptive statistics i.e. Frequencies, Means and percentages were presented in tables, graphs and figures. The Chi-square test was used to determine the association between variables of the predominant African and Caucasian body shapes. For example, an association between body shape and body part cathexis, body shapes and RTW apparel fit problems, body shapes and RTW fit preferences, body shapes and perceived ideal figure, body part cathexis and RTW apparel fit problems, body part cathexis and RTW apparel fit preferences, as well as RTW apparel fit problems and RTW apparel fit preferences of predominant African and Caucasian body shapes.

4.7.2.3 Explanation of statistical methods used

Descriptive statistics

Descriptive statistics are numerical measures that describe a distribution by providing information on the central tendency, i.e. the Mean, Median and Standard Deviation. A Mean is the sum of all scores in a distribution divided by the number of cases; a Median is the middle score in a distribution after scores have been arranged in an ascending or descending order. It should be noted that unlike the Mean, the Median value is not influenced by extremely low or high scores (outliers), and is considered in some statistical tests such as the Kruskal-Wallis test (Argyrous, 2000:69; Jackson, 2012:116). The standard deviation is a measure of dispersion showing the average distance of all the scores in the distribution from the Mean. It is the square root of the average squared deviation from the Mean (Argyrous, 2000:76; Jackson, 2012:120). In this study, body shape classes were categorised between the minimum and maximum ranges by varying the Mean ± Standard Deviation (Beazley, 1998; Gupta & Gangadhar, 2004; Winks, 1991) according to body shape descriptors. This study utilised descriptive statistics when categorising, analysing and comparing prevalent body shapes, comparing visual scan images, selected body measurements and measurement ratios, describing perceived RTW apparel fit problems and fit implications associated with predominant African and Caucasian body shapes on selected body parts, describing body part cathexis and perceived ideal figures and RTW apparel fit preferences of predominant African and Caucasian body shapes.

The Chi-square test

The Chi-square test is a non-parametric test used to determine a relationship between two categorical variables. It compares the observed frequencies in certain categories to frequencies that might be expected to be obtained by chance. The Chi-square test is based on a null hypothesis: H_0: There is no significant relationship in selected variables of predominant African and Caucasian body shapes, and an alternate hypothesis H_a: There is a significant difference in selected variables of African and Caucasian body shapes. Where the p-value is less than the alpha (significance) level of 0.05 ($p < 0.05$), the null hypothesis is rejected, which indicates a significant relationship between the selected variables. The assumptions underlying the Chi-square test are that the sample is randomly selected, the observations are independent, the data is nominal and there are expected frequencies of less than 5 in not more than 25% of the cells in the contingency tables, otherwise the Chi-square test is invalid (Field, 2005:600; Jackson, 2012:272). In this study the Chi-square test was used to establish relationships between body shapes and ethnicity.

The Kruskal-Wallis test

The Kruskal-Wallis test is a non-parametric test that was used on ordinal data and also because some of the body shape groups had only a few subjects or observations (Field, 2005:466). It was used to establish significant differences in the key dimensions of the predominant African and Caucasian body shape categories on selected body parts. To test for significant differences in the selected body measurements of African and Caucasian women, the null hypothesis was: H_0: There is no significant difference in selected measurements or ratios of African and Caucasian body shapes, and an alternate hypothesis H_a: There is a significant difference in selected body measurements or ratios of African and Caucasian body shapes. Where the p-value is less than the alpha (significance) level of 0.05 ($p < 0.05$), the null hypothesis is rejected as it shows a significant difference in the body measurement or ratio in question. Body shapes with measurements that recorded significant differences at the 5% level of significance were further subjected to pair-wise comparisons, i.e. *post-hoc* tests to determine body shape groups that recorded significantly different body measurements. Take note that the *post-hoc* tests compare Median values of all combination pairs of the three predominant body shapes (Field, 2005:689).

Parallel box plots (**Figure 4.3**) were used as visual representation of the Kruskal-Wallis test results. The box of the plot is a rectangle representing the central 50% of the sample (inter-quartile range) around the Median, represented by a solid square, the upper and lower 25% are represented by the whiskers on either sides of the rectangle, the crossbar at the end of each whisker indicates the minimum and maximum values, outliers and extreme values are indicated by circles (o) and asterisks (+) respectively above and below each crossbar of all box plots representing each of the six body shapes. The length of the box/ rectangle indicates the variability of the sample; a smaller box represents a close concentration of scores around the median, and a larger box represents scores that are widely dispersed around the median (**Figure 4.3**).

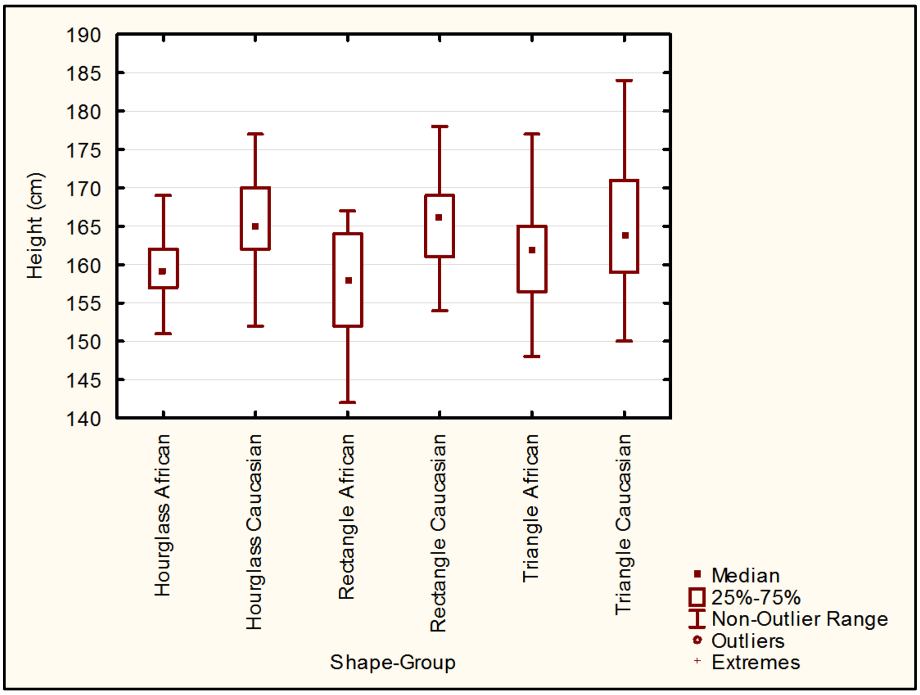


FIGURE 4.3: AN EXAMPLE OF BOX PLOTS

4.8 QUALITY OF DATA

This section explains how the present study was conducted to ensure validity and reliability of the data and subsequently the results, how this study ensured that these instruments measured the variable(s) they claim to measure, and how consistent and accurate they measured the concepts in question. The data collection instruments are: the 3-D body scanner, the questionnaire and the Body Shape Assessment Scales.

4.8.1 Validity of data collection instruments

De Vos *et al*. (2005:160-62) describe validity of an instrument as the degree with which the instruments measure the variable(s) it claims to measure. It indicates whether it accurately measures the concept in question. There are several dimensions of validity that measure different aspects of an instrument, namely: face, construct, criterion, content and predictive validity.

- **Face validity**

Face validity is regarded as the simplest and least scientific method to measure the validity of an instrument. It is concerned with the outward appearance of the measurement procedure, i.e. if the instrument appears to measure what it claims to measure and if the questions in the instrument seem relevant to the concepts being measured (Rubin & Babbie, 2007:194). An in-depth literature survey was conducted to help identify and define all the concepts related to body shapes, RTW apparel fit problems and preferences as well as body part cathexis. These concepts are also relevant to the objectives of the study, which formed the basis for the formulation of research questions (Kumar, 2005:156). They were incorporated in the questionnaire to ensure that the questions measured the concept(s) they appeared to measure. The literature consulted further identified concepts that were used in framing questions to ensure that the instrument covers all areas relating to body shapes, body part cathexis, RTW apparel fit problems and preferences. Furthermore, the instruments were pre-tested on a smaller sample with similar qualities as the target population to ensure that the items of the questionnaire measure what they intended to measure (Ruane, 2005:63). Experts with over ten years' experience in clothing and textiles reviewed and critiqued the data collection instruments; thereafter, some modifications were made.

- **Construct validity**

Construct validity refers to the degree to which a measuring instrument successfully measures the variables as expected within a system of theoretical relationships (De Vos, 2005:161). The literature search identified and defined concepts relevant to the objectives of the study, and these were included in the instrument and formed a basis for formulating questions to measure similar concepts (Kumar, 2005:156).

- **Criterion validity**

Criterion validity demonstrates a measure's validity by indicating that a measure is able to predict a certain outcome. It is objective evidence that the instrument is measuring what it claims to measure. Criterion validity compares the scores on an instrument with external criteria known to measure the concept being studied (De Vos, 2005:161). This study utilised acknowledged scales whose scores have generally understood meaning like the body cathexis scale that was first formulated in 1953 (Secord & Jourard, 1953). This scale has been adapted, modified and used previously by a number of studies (Feather *et al*., 1996; Petrie *et al*., 2002) over the years.

- **Content validity**

Content validity is concerned with the degree to which a measure covers the range of meanings included within a concept (Babbie, 2005:147; Terre Blanch *et al*., 2006:147). It ensures representativeness or sampling adequacy of the content, i.e. items or topics in the instrument adequately represent the concepts being measured. The literature consulted identified concepts that were used in framing questions to ensure that the instrument covers all areas relating to body shapes, body cathexis, fit preferences and RTW apparel fit.

4.8.2 Reliability of data collection instruments

Reliability refers to the consistency of the measurement, i.e. measuring instruments that repeatedly yield the same results (Ruane, 2005:67). An instrument that is dependable, consistent, predictable, stable, repeatable, reproducible, generalisable and accurate is said to be reliable (De Vos, 2005:161; Hardy & Bryman, 2004). A pilot test was conducted to allow the data collection instruments to be tested and modified to improve the success and effectiveness of the investigation (De Vos *et al*., 2005:210). Three-dimensional body scanning is dependable and has consistent, predictable and stable technology that gives accurate outcomes and therefore can be said to be reliable. In addition, body scanning has been used successfully in a number of studies abroad. Its use in this study was expected to yield consistent results, and so are the pre-determined standards for body shape classification used as well as body cathexis scales and Body Shape Assessment Scale. Also, to ensure reliability of the instruments, experienced experts validated the data collection instrument.

4.9 ETHICAL CONSIDERATIONS

Ethics is associated with morality and matters of right and wrong. This study required scanning participants' bodies and answering personal questions, both of which are intrusive. Therefore, the researcher sought participants' consent to do this research (Babbie, 2005:61).

Furthermore, the objectives of this study as well as its data collection procedure were explained in the consent letter. Participants were assured that body scanning was not going to cause them any harm, and the confidentiality and anonymity of information gathered was guaranteed. A separate and enclosed change room and a private scanning cubicle were provided to ensure participants' privacy. Participants were also assured that they were not going to be identifiable from the scan images. Anonymity was ensured as information about the participants was under no circumstances going to be linked to them, and information gathered from participants was strictly going to be used for research purposes and would not be published in any other format (Wagenaar & Babbie, 2004:41). The consent letter further elaborated on how the study was expected to benefit consumers as well as the South African apparel industry, as it would to some extent contribute to manufacturing of apparel with improved and satisfactory fit. Participants were informed that they were at liberty to withdraw from the research at any time. To adhere to hygiene standards, the scanning garments provided were worn over participants' own undergarments, and were laundered after each use and individually hung and steam pressed before being used by other participants. Furthermore, a research proposal was submitted to the ethics committee of the University of Pretoria for approval. The committee ensured that all the necessary ethical considerations were observed. Also, the consent form/letter (**Addendum 1**) was signed by participants before commencement of the data collection exercise, as Creswell (2003:64) suggests.

CHAPTER 5: DATA ANALYSIS, DISCUSSION & INTERPRETATION

5.1 INTRODUCTION

This chapter gives a detailed account of the data analysis, discussion and interpretation of the findings of this study. Data was collected using a three-dimensional (3-D) full body scanner, a questionnaire and a body shape assessment scale. The findings from all three instruments were analysed and presented according to the primary and sub-objectives of this study. Data addressing the same objectives was consolidated and presented together. Scan data consisted of body measurements and virtual images. The questionnaire gathered data on consumer profile, body part cathexis, perceived RTW apparel fit problems and fit preference at the selected body parts. The Body Shape Assessment Scale assisted in the visual assessment and subsequent verification of participants' body shapes that were assigned from their body measurements.

5.1.1 Analysis of consumers' profile data

The demographic data of the participants indicates that there was a total of two hundred and thirty four (n = 234) respondents: 47% (n 1 = 109) African and 53% (n 2 = 125) Caucasian women who belong to the Generation Y (18-25 years) consumer segment (**Figure 5.1**). This sample size was reached based on sample sizes used in studies that utilised 3-D body scan data (Connell *et al*., 2001; Connell *et al*., 2003; Devarajan & Istook, 2004; Mastamet-Mason, 2008:151). All the participants had to complete questionnaires, and be scanned to obtain 3-D scan images from which measurements were extracted. Scan images were visually analysed using a Body Shape Assessment Scale that was formulated based on body shape descriptors outlined in the literature and was also adapted from the one used in Mastamet-Mason (2008:297) (**Addendum 3**).

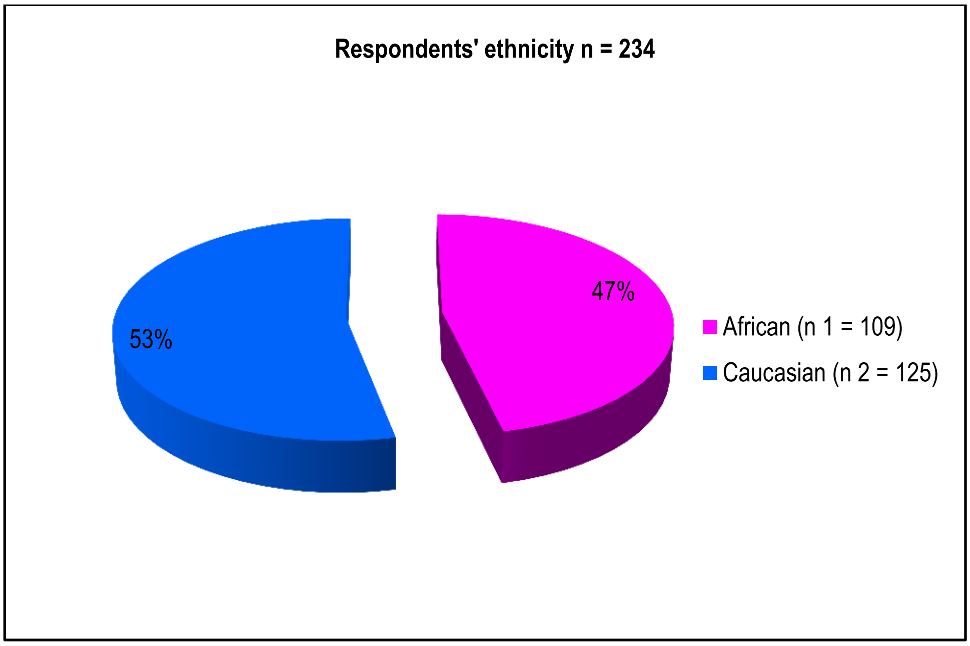


FIGURE 5.1: RESPONDENTS' ETHNICITY

5.2 IDENTIFICATION, CATEGORISATION AND COMPARISON OF YOUNG AFRICAN AND CAUCASIAN WOMEN'S BODY SHAPES FROM BODY MEASUREMENTS AND SCAN IMAGES (OBJECTIVE 1 & SUB-OBJECTIVES 1.1 & 1.2)

This part of the findings addressed the first objective of this study, which sought to identify and compare the body shapes of African and Caucasian women. Identifying and understanding predominant shapes is important for the apparel industry in its effort to improve apparel fit. The body shapes of the two ethnic groups were classified using the relationship between key body measurements, i.e. drop values. Drop values are one method of body shape classification used in a number of studies (Simmons *et al*., 2004a; 2004b; Lee *et al*., 2007). At first, several attempts were made to classify the bodies of African and Caucasian women into different body shape categories. As a starting point the mathematical description of body shapes used in the Female Figure Identification Technique (FFIT) and body shape classification parameters used in a study by Lee *et al*. (2007) were used. This study (Lee *et al*., 2007) was comparing and classifying bodies of US and Korean women. The parameters used were formulated based on the underlying body shape descriptors outlined in Rasband (1994), which were also used for the FFIT software that was initially used to classify US women (Simmons *et al*., 2004a; 2004b). However, these body shape descriptors were very general, as they could not specify mathematical formulae or specific parameters guiding each body shape classification. Since the FFIT software was successful in classifying the body shapes of US and Korean women, it was believed that it would also yield the same results in the classification of African and Caucasian women.

The study by Lee *et al*. (2007) combined two or more mathematical formulae to define each body shape category. For instance, the classification of the hourglass shape was based on the drop values bust – waist ≥ 22.9 cm or hips – waist ≥ 25.4 cm; for triangle shape the drop values hips – bust ≥ 9.1 cm and hips – waist < 22.9 cm were used; to classify inverted triangle the drop value bust – waist < 22.9 cm was used; and rectangular shape had drop values bust – waist < 22.9 cm and hips – waist < 25.4 cm. Mastamet-Mason (2008:151) modified and used the above parameters, formulae and drop values of a different sample to successfully classify body shapes of Kenyan women. The resulting formulae for the five predominant body shapes were 14.0 cm ≤ hip – bust ≤ 26.0 cm for triangle, –8.0 cm ≤ hip – bust ≤ 3.2 cm (min) for inverted triangle, 23.0 < bust – waist ≤ 36 cm (max) for hourglass, 4.7 cm < bust – waist ≤ 23.0 cm for rectangle, and –13.0 cm (min) ≤ bust – waist ≤ 4.7 cm for apple.

In the absence of the FFIT software, at first this study utilised the same formulae as outlined by Lee *et al*. (2007) to classify African and Caucasian women's bodies. However, the outcome was such that there were overlaps in the classification as participants were classified into more than one body shape category. Furthermore, after the body shapes of African and Caucasian women were assigned using the FFIT body shape descriptors and parameters, they were visually analysed. However, they looked different and could not be confirmed visually. Since body shapes vary from one population to the other, while body shape descriptors of different populations may be similar, the defining parameters could be different and specific to different populations of varying age groups, as it was confirmed in the study by Mastamet-Mason (2008:151). It is for this reason that apparel manufacturers fail to satisfy different female consumer populations using dimensions and shapes of standard or ideal figures. Moreover, body shapes, sizes and proportions of South African women (African and Caucasian) differ from those of US or Korean women. They therefore needed to be classified using different parameters from those used in the study by Mastamet-Mason (2008:151).

It should also be noted that these studies: Simmons *et al*. (2004a; 2004b), Lee *et al*. (2007) and Mastamet-Mason (2008:151) classified participants of different age groups. Lee *et al*. (2007) classified US and Korean women aged between 18 and 66 years, while Mastamet-Mason (2008:151) classified Kenyan women aged 25-55. It is clear that body shape changes as one gets older, hence the differences in body shape prevalence observed among different populations and age groups. As a result, the FFIT parameters and mathematical formulae could not be adopted in the present study, especially in the absence of the FFIT software. The body shape descriptors that are based on the relationship between key dimensions had previously been successfully used in the study by Mastamet-Mason (2008:151). They were adapted and used again in this study based on body measurements of the sampled African and Caucasian young women. However, the subjects in Mastamet-Mason (2008:151) were older than those in the current study. This then necessitated adjustments of the parameters, using drop values of the sample and mean ± standard deviation to come up with new parameters that were specific to the younger sample. The body shapes adopted in the current study were first assigned using drop values of the subjects' key measurements outlined in **Table 5.1** and were adopted following visual assessment and confirmation by two expert sensory evaluators.

5.2.1 Identification, categorisation and comparison of African and Caucasian body shapes (Objective 1)

The body shape parameters subsequently adopted in this study to classify African and Caucasian participants' body shapes are outlined in **Table 5.1**.

TABLE 5.1: AFRICAN AND CAUCASIAN WOMEN'S BODY SHAPE DEFINING PARAMETERS

1st STEP: Triangular and Inverted triangular are guided by the principle that a Triangular shape has a bust smaller/narrower than hips, Inverted Triangular has a bust wider/larger than hips. (Once classified, these will no longer be subjected further to bust-waist relationship.)				
Drop values Hip subtract Bust	**Mean**	**SD**	**Minimum**	**Maximum**
	12.6 cm	5.7	0.09 cm	29.8 cm
BODY SHAPE CLASSES		**DEFINING PARAMETERS**		
TRIANGULAR		Mean to Max **12.6 ≤ hip – bust ≤ 29.8**		
INVERTED TRIANGULAR		**hip – bust < 0**		
2nd STEP: Hourglass and Rectangular shapes both have smaller waist than bust, the difference being Hourglass has a higher drop value than Rectangular. Apple shape has fuller/rounder bust, waist and hips, the waist may be slightly wider or almost equal to the bust.				
Drop values Bust subtract Waist	**Mean**	**SD**	**Maximum**	**Minimum**
	18.0 cm	4.1	-3.7 cm	26.6 cm
BODY SHAPE CLASSES		**DEFINING PARAMETERS**		
HOURGLASS		Mean ≤ bust – waist ≤ Max. **18 ≤ bust – waist ≤ 26.6**		
RECTANGULAR		Mean (18 cm) – 3xSD (12.3 cm) < bust – waist < mean **5.6 < bust – waist < 18**		
APPLE		Minimum ≤ bust – waist ≤ Mean (18 cm) – 3xSD (12.3) **-3.7 ≤ bust – waist ≤ 5.6**		

(Adapted from Lee *et al*., 2007; Mastamet-Mason, 2008; 151) Measurements are in cm.

Table 5.2 presents the findings of the body shape classification from drop values outlined in **Table 5.1**. The most prevalent body shapes among the sampled African group (n_1 =109) was the triangular shape (58.7%), followed by the hourglass (27.5%), and the rectangle (12.8%). The least common was the apple figure shape (0.9%). Furthermore, the most prevalent body shape among the sampled Caucasian group (n_2 = 125) was 40.8% the hourglass shape, followed by 33.6% triangular and 25.6% rectangular shape.

TABLE 5.2: STATISTICS TABLE FOR BODY SHAPE CLASSIFICATION BY ETHNIC GROUP

Body shape categories	Classification by ethnic group			Chi-square p-value
	African Count (column %)	Caucasian Count (column %)	Total Count (column %)	
Triangle	64 (58.7)	42 (33.6)	**106 (45.3)**	**0.0004**
Hourglass	30 (27.5)	51 (40.8)	**81 (34.6)**	
Rectangle	14 (12.8)	32 (25.6)	**46 (19.7)**	
Apple	1 (0.9)	0 (0)	**1 (0.4)**	
Total	**109 (47)**	**125 (53)**	**234 (100)**	

There were no participants classified as apple shaped among the Caucasian group. There were also no participants classified as inverted triangle among both the sampled African and Caucasian women. This is an indication that the body shape characterised by a larger bust than hips was not common among the 18- to 25-year old African and Caucasian women who participated in this study. Even though there were fuller figured participants among the African and Caucasian participants, their drop values show that most of them are not apple shape but are either hourglass, triangular or rectangular, except for 1 (0.92%) apple shaped African participant. Almost all the other African and Caucasian women were classified into three predominant shapes, namely: triangle, hourglass and rectangle. Further comparisons and discussions henceforth will be about the three predominant body shapes, namely: triangle, hourglass and rectangular shapes.

5.2.2 Association between body shape and ethnicity (Objective 1.2)

This study further investigated whether there was a significant association (or relationship) between the three predominant body shapes and ethnicity (African and Caucasian ethnic groups). The Chi-square p-value of 0.0004 indicates a significant relationship/association between the three predominant body shapes and ethnicity. This means that the triangle, hourglass and rectangle shapes were the three most prevalent body shapes among the African and the Caucasian ethnic groups, in differing numbers (**Table 5.2**). The majority of African participants were triangular in shape, followed by hourglass and lastly rectangle, while the hourglass was the most prevalent, triangle was the second highest followed by the rectangle body shape among the Caucasian participants (**Table 5.2**). It should be noted that the Chi-square test was only conducted between the three predominant body shapes of the two ethnic groups, which excluded the minority apple shape. A cross-cultural study (Lee *et al*., 2007) also discovered differences in body shape prevalence among Korean and US women. This was evidence that body shape prevalence varies by ethnicity, as was observed between the samples of African and Caucasian women.

This study was based on the assumption that the Western hourglass is similar to the Caucasian hourglass. It revealed that, of the 234 African and Caucasian participants, there were 51 (21.8%) Caucasian (Western) hourglass. The fashion industry bases RTW apparel production on a standard figure, i.e. the Western hourglass shape, which in this study is assumed to be similar to the Caucasian hourglass. This means that the rest of the participants (78.2%) are more likely to experience RTW apparel fit problems. This figure also includes the 30 (12.8%) African hourglass shaped women whose bodies also differ from those of the Caucasian hourglass. It is therefore recommended that the apparel industry identifies and caters for the most common figure shapes. For instance, in this study the majority of the 234 participants were triangular shaped (45.3%), followed by hourglass (34.6%). It would therefore be wise for the apparel industry to consider catering for the most prevalent body shapes, i.e. the triangular as well as the hourglass shape (**Table 5.2**), and to take into consideration the variations within these body shapes that are due to ethnic differences.

5.3 COMPARISON AND DETERMINATION OF SIGNIFICANT DIFFERENCES IN SELECTED BODY MEASUREMENTS AND RATIOS OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES (OBJECTIVE 2 & SUB-OBJECTIVE 2.1)

This study further compared selected measurements of African and Caucasian women. The selected measurements were extracted at bust, stomach, waist, abdomen, hip, seat, and thigh levels of the 3-D body scan images**.** These body parts are some of the critical fit points that are also crucial in the classification of body shapes. Measurements extracted at these locations included circumferential, height, width dimensions as well as body protrusions and extensions. Ratios of key circumferential and height dimensions were computed to establish how these dimensions relate. Ratios of interest in this study were bust to waist, hip to waist, and bust to hip circumferential ratios, as well as total body to bust, total body to waist, total body to hip and total body to knee height ratios. The relationship between key measurements/ratios impacts on RTW apparel fit.

The Kruskal-Wallis test was used to further establish whether there were significant differences in the key dimensions of the three predominant African and Caucasian body shape categories on selected body parts. The Kruskal-Wallis test is a non-parametric test that was used because the data collected using the questionnaire was on an ordinal scale and also because some of the body shape groups had only a few subjects or observations (Field, 2005:466).

To test for significant differences in the selected body measurements of African and Caucasian women, the null hypothesis was: H_0: There is no significant difference in selected measurements or ratios of African and Caucasian body shapes, and an alternate hypothesis H_a: There is a significant difference in selected body measurements or ratios of African and Caucasian body shapes. Where the p-value is less than the alpha (significance) level of 0.05 ($p < 0.05$), the null hypothesis is rejected as it shows significant difference in the body measurement or ratio in question. This study was interested in the planned pair-wise comparisons (summarised in **Table 5.3**) of the same African and Caucasian body shapes, e.g. African hourglass and Caucasian hourglass shapes, as well as paired comparisons of the three predominant body shapes within each ethnic group, e.g. African hourglass and African triangle or African hourglass and African rectangular or African triangle and African rectangle shapes. Furthermore, in order to investigate and understand the RTW apparel fit problems experienced by the different body shapes, this study further compared all the predominant body shapes to the Caucasian (Western) hourglass. This is believed to be the standard figure which is used by the apparel industry as a base figure for designs. However, it should be noted that already from the above body shape pairs the Caucasian hourglass has already been compared (paired) with all the other body shapes, except the African triangle and African rectangle; therefore, this comparison shall be in a separate discussion.

TABLE 5.3: PLANNED BODY SHAPE PAIR-WISE COMPARISONS

Similar African and Caucasian comparisons	Comparisons of predominant African shape pairs	Comparisons of predominant Caucasian shape pairs	Comparisons of predominant body shapes and Caucasian hourglass shape pairs
African triangle and Caucasian triangle	African triangle and African hourglass	Caucasian triangle and Caucasian hourglass	African triangle and Caucasian hourglass
African hourglass and Caucasian hourglass	African triangle and African rectangle	Caucasian triangle and Caucasian rectangle	African rectangle and Caucasian hourglass
African rectangle and Caucasian rectangle	African hourglass and African rectangle	Caucasian hourglass and Caucasian rectangle	–

Body shapes with measurements that recorded significant differences at a 5% level of significance were further subjected to pair-wise comparisons, *post-hoc* tests to determine which body shape groups differ from one another. Take note that the *post-hoc* tests compare the median values of all combination pairs of the three predominant body shapes (Field, 2005:689). Body shape pairs with significantly different body measurements/ratios on a 5% level of significance had these symbols "*" and "#". For instance, the bust circumference of African triangle and Caucasian hourglass as well as Caucasian triangle and Caucasian hourglass were significantly different and therefore had the symbols "*" and "#" respectively. Multiple body shape pairs with significant differences per body part had the symbol "#" and a number next to it to differentiate the pairs of body shapes compared at a time. For example, **Table 5.4** shows that there were three body shape pairs that recorded significant differences in thigh circumferences. These were the African triangle and Caucasian hourglass shapes, which both had the symbol "*" and the African triangle and Caucasian triangle that both had the symbol "$\#^1$" as well as the African triangle and African hourglass as indicated by "$\#^2$".

Table 5.4 shows that all the circumferential measurements of the different body shapes recorded p-values less than 0.05 at selected body parts, which indicates significant differences in the measurements of the body shapes being compared. Take note that some of the body shape pairs had significant differences that lay outside planned comparisons of interest in this study and have p-values with an asterisk "**". For example, **Table 5.4** shows that at the stomach a significant p-value (p = 0.0398**) for the stomach, yet none of the paired body shapes bears these symbols "* or #", which either means that significant differences at 5% were not between the body shape pairs outlined in **Table 5.3**, or it meant that significant differences lay outside the planned comparisons. This study will only discuss significant differences between the body shape pairs outlined in **Table 5.3**.

This study compares selected body measurements and ratios and presents findings in three subsections. The first subsection comprises a comparison of measurements and ratios of African and Caucasian women of the same body shapes; the second subsection compares measurements and ratios of the three predominant African body shapes and compares the measurements and ratios of the three predominant Caucasian body shapes. The third subsection compares measurements and ratios of Caucasian hourglass and all other body shapes. The mean, median, standard deviation, as well as Kruskal-Wallis p-values are presented in each table. For example, **Table 5.4** presents the above statistics of selected circumferential measurements of the six body shapes.

Box plots are also included as visual representation of the Kruskal-Wallis test results. Box plots show the distribution of the central 50% (inter-quartile range) around the median, the upper and lower 25% as well as outliers and extreme values of all six body shapes. For example, in **Figure 5.21** the smaller box represents the middle 50% of the Caucasian hourglass who had their abdomen circumference closely concentrated around the median. In contrast, the larger box represents abdominal circumferences of the African rectangle that were widely dispersed around the median. This study only discusses *post-hoc* tests of body shapes that show significant differences in the different measurements. Box plot illustrations will only be presented for body measurements that recorded significant differences within the planned comparisons. It should be noted that a box plot for each body measurement will show all six body shape groups even when the *post-hoc* test discussed is between the three predominant African or Caucasian body shape pairs. This is because the Kruskal-Wallis test compares all six body shapes at once. Each box plot has a footnote that states the body shapes that have significantly different measurements.

5.3.1 Comparison of significant differences in selected circumferences of predominant African and Caucasian body shapes

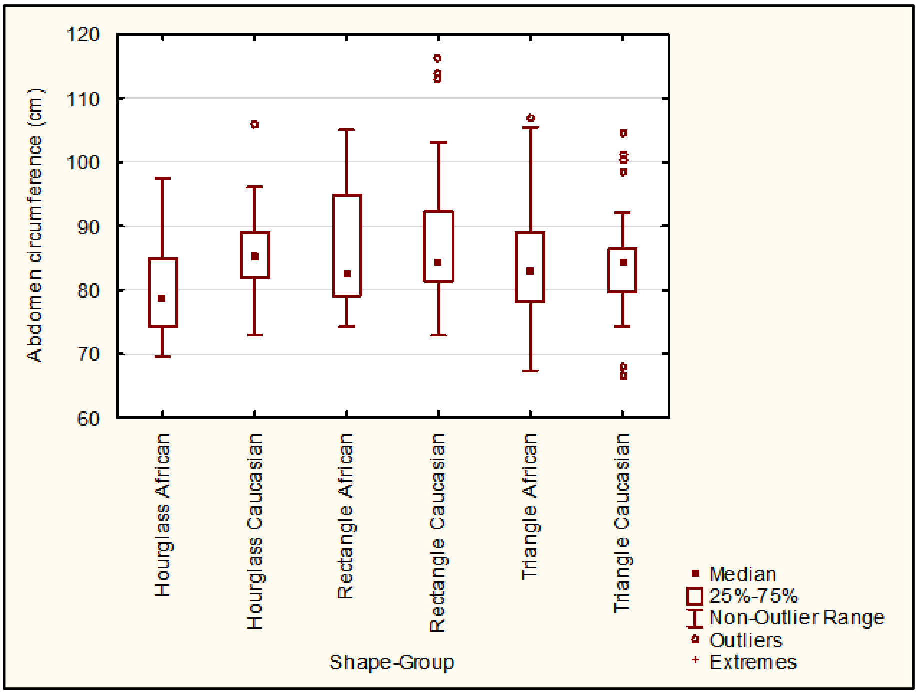
Circumferential measurements in this study were extracted at maximum circumference at each level, i.e. from the right-hand side trunk seam, over the corresponding point on the left-hand side, back to the right side at the fullest part of the 3-D body image (**Table 4.2** in **Chapter 4**). This study investigated how the bust, stomach, waist, abdomen, hips, seat/buttocks and thigh circumferences of predominant African and Caucasian body shapes compare. It should be noted that the p-value given for each body part is an overall p-value for the comparisons of all six body shape groups.

The Kruskal-Wallis test was conducted on paired body shapes to determine whether the selected measurements of the paired body shapes were significantly different at a 5% level of significance. A Kruskal-Wallis test of $p < 0.05$ indicates a significant difference and the symbols *, $\#^{1-3}$ show significantly different body shape pairs. The pair-wise comparison revealed that African and Caucasian rectangular body shapes show no significant differences in circumferences of all the selected body parts. African and Caucasian hourglass shapes also recorded no significant differences in circumferences of all the selected body parts, except at the abdomen and thighs. The abdominal circumference of the Caucasian hourglass was significantly larger (85.3 cm) than that of the African hourglass (80.3 cm). **Table 5.4** and **Figure 5.2** show that the abdominal circumference of the African hourglass was 5 cm less than that of the Caucasian hourglass, as indicated by *. On the other hand, the African and Caucasian triangular shapes also recorded significant differences for thigh circumferences. Specifically, African triangular women had thighs that were 4.2 cm larger than Caucasian triangular women, indicated with $\#^2$ in **Table 5.4** and **Figure 5.3**. These differences indicate that participants of the same body shape but different ethnic groups have different body measurements at some of the key body parts, as it was observed with hourglass and triangular shapes who recorded significantly different abdomen and thigh circumferences respectively.

TABLE 5.4: COMPARISON OF CIRCUMFERENTIAL MEASUREMENTS OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES

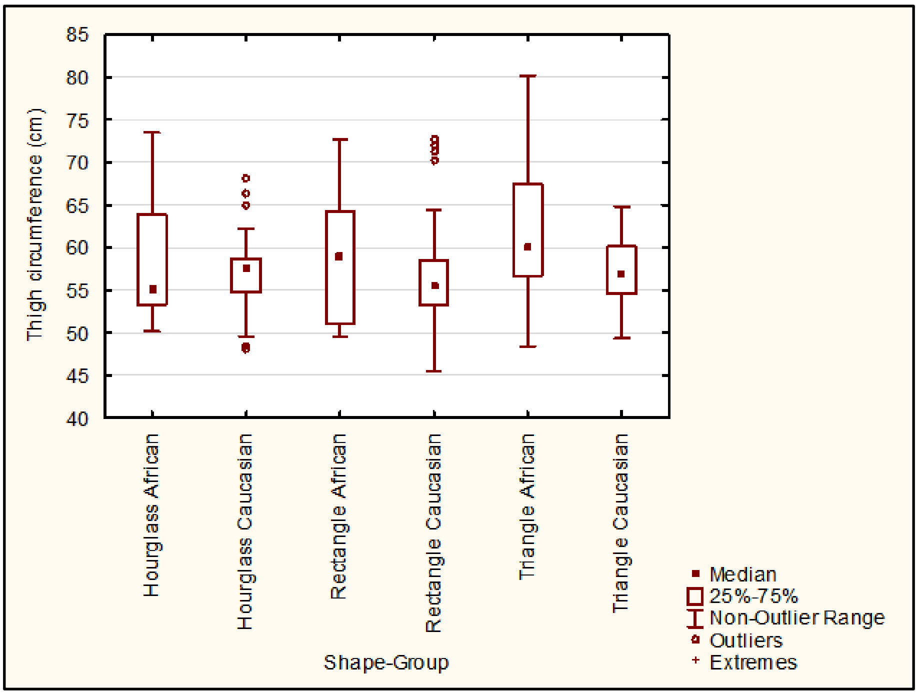
Dimension		African triangle	Caucasian triangle	African hourglass	Caucasian hourglass	African rectangle	Caucasian rectangle	Mean differences in cm	Kruskal-Wallis p-value
Bust Circumference	Mean (Standard deviation)	87.7 (6.87)	86.5 (4.70)	90.6 (7.00)	92.3 (5.23)	91.7 (9.52)	90.6 (9.42)	4.6* 5.8#	**0.0000**
	Median	85.9	85.9	89.9	92.3	89.5	89.0		
	Significant difference	*	#		* #				
Stomach Circumference	Mean (Standard deviation)	73.6 (6.41)	71.1 (4.31)	73.2 (5.42)	73.7 (5.28)	78.6 (9.50)	75.6 (9.90)	–	**0.0398****
	Median	72.6	70.9	72.3	72.9	76.9	72.8		
Waist Circumference	Mean (Standard deviation)	70.5 (7.00)	69.0 (5.23)	69.2 (6.24)	71.0 (4.72)	75.8 (10.4)	76.7 (10.9)	7.7*	**0.0026**
	Median	69.0	69.0	67.5	70.1	72.1	73.6		
	Significant difference		*				*		
Abdomen circumference	Mean (Standard deviation)	84.7 (9.43)	84.1 (7.50)	80.3 (7.59)	85.3 (5.79)	86.6 (9.67)	88.0 (11.1)	5*	**0.013**
	Median	82.8	84.4	78.9	85.1	82.6	84.5		
	Significant difference			*	*				
Hip circumference	Mean (Standard deviation)	106.0 (8.40)	102.7 (5.65)	99.1 (6.80)	99.8 (4.92)	101.7 (8.21)	100.6 (8.61)	6.2* 6.9#	**0.0000**
	Median	104.0	101.8	97.4	99.9	101.7	99.5		
	Significant difference	* #		#	*				
Seat Circumference	Mean (Standard deviation)	101.7 (8.4)	98.7 (5.46)	95.8 (6.17)	96.9 (4.79)	97.4 (8.40)	97.6 (8.63)	4.8* 5.9#	**0.0032**
	Median	99.8	97.7	94.5	96.9	97.1	95.7		
	Significant difference	* #		#	*				
Thigh Circumference	Mean (Standard deviation)	61.4 (6.79)	57.2 (3.89)	57.7 (6.20)	57.1 (3.90)	59.4 (7.60)	56.9 (6.94)	4.3* 3.7$\#^1$ 4.2$\#^2$	**0.0012**
	Median	60.0	56.7	55.2	57.5	59.0	55.4		
	Significant difference	* $\#^1$ $\#^2$	$\#^2$	$\#^1$	*				

Bold p-values are statistically significant at 5%; *, $\#^1$, $\#^2$ indicate statistically different pairs, and ** significant difference may be above 5% or lie outside planned comparison in this study



Significant difference between African and Caucasian hourglass

FIGURE 5.2: COMPARISON OF ABDOMEN CIRCUMFERENCE OF AFRICAN AND CAUCASIAN BODY SHAPES

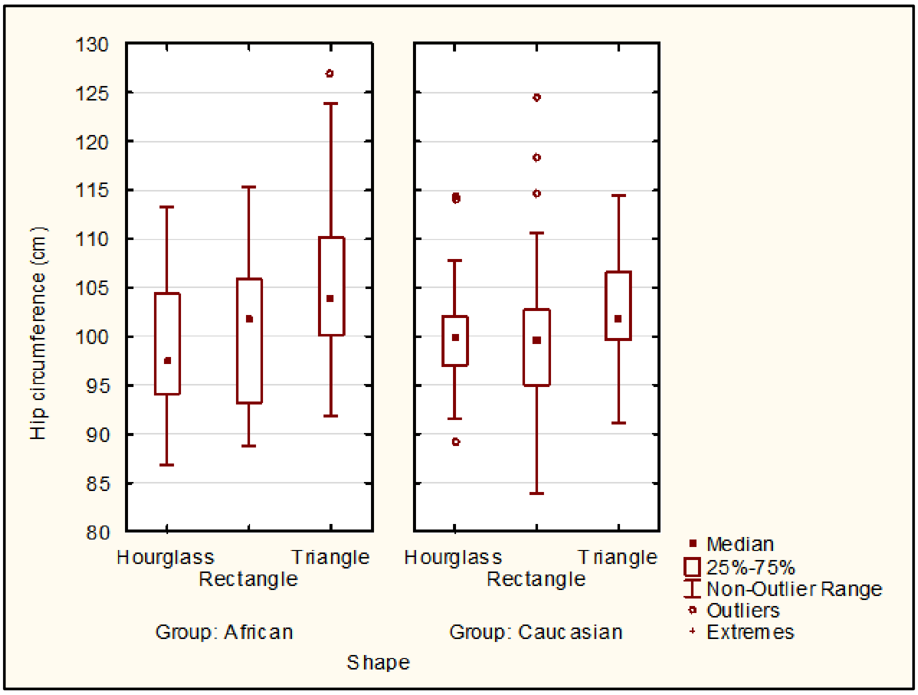


Significant differences between African triangle and Caucasian hourglass, between African triangle and Caucasian triangle, and between African hourglass and Caucasian hourglass

FIGURE 5.3: COMPARISON OF THIGH CIRCUMFERENCE OF AFRICAN AND CAUCASIAN BODY SHAPES

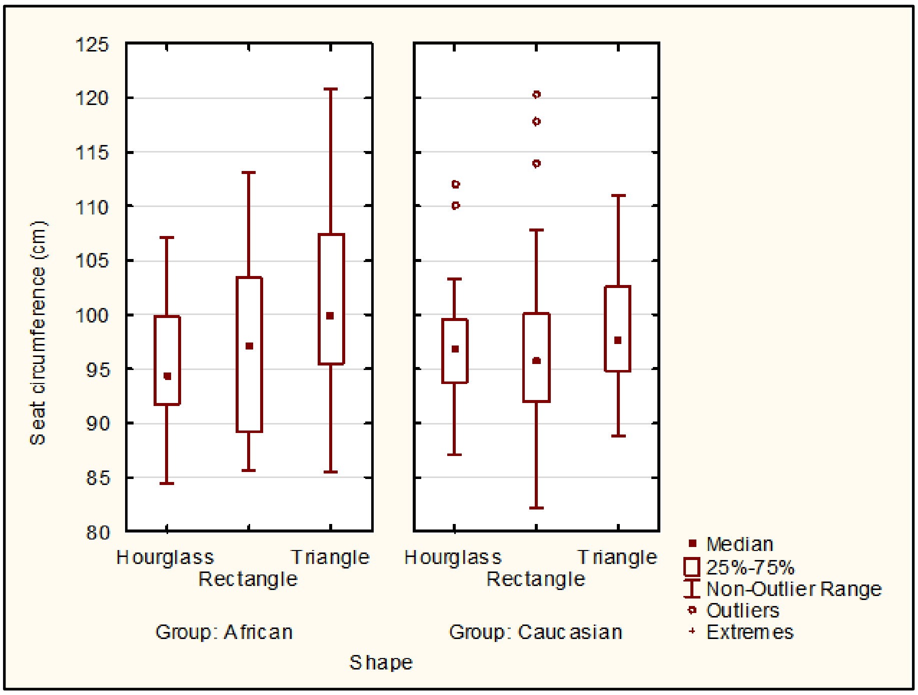
5.3.2 Comparison of significant differences in selected circumferences of the three predominant African body shapes

This study further investigated how circumferences of predominant African body shape pairs compare. This comparison showed no significant differences in bust, stomach, waist and abdomen circumferences of all three African body shapes. However, African triangular and African hourglass women recorded significant differences in hip, seat and thigh circumferences (**Table 5.4**). Specifically, African triangular shapes had significantly larger hips (106.0 cm), buttocks (101.7 cm) and thighs (61.4 cm) than their hourglass counterparts, who had 99.1 cm, 95.8 cm and 57.7 cm respectively, as indicated by # and #[1] in **Table 5.4**. Larger hips, thighs and fuller buttocks are typical characteristics of triangular body shapes (Rasband, 1994:12; Rasband & Liechty, 2006:24). An hourglass shape by contrast is characterised by smoothly rounded hips and buttocks that appear proportionally larger than what they are because of the smaller indented waist (Rasband, 1994:13; Rasband & Liechty, 2006:25). Visual representation of differences in hips, seat and thigh circumferences of all the African body shapes are illustrated in **Figures 5.4, 5.5** and **5.3** respectively. The variation in body shapes of participants who belong to the same ethnic group proves that women from the same population should not be assumed to have the same body shape. Even if participants from the same ethnic group have the same body shapes, there may be variation in some of the body measurements. This means that the fashion industry should base RTW apparel production on more than one standard body shape to satisfy the main body shapes prevalent within a population.



Significant differences between African triangle and African hourglass, and between African triangle and Caucasian hourglass

FIGURE 5.4: COMPARISON OF HIP CIRCUMFERENCE OF AFRICAN AND CAUCASIAN BODY SHAPES

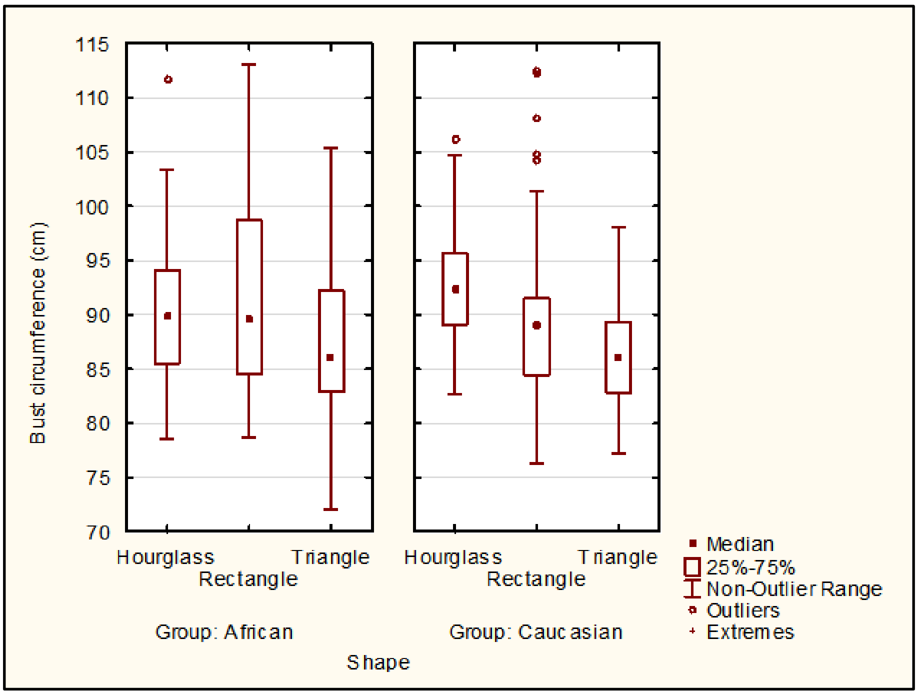


Significant differences between African triangle and African hourglass, and between African triangle and Caucasian hourglass

FIGURE 5.5: COMPARISON OF SEAT CIRCUMFERENCE OF AFRICAN AND CAUCASIAN BODY SHAPES

5.3.3 Comparison of significant differences in selected circumferences of predominant Caucasian body shapes

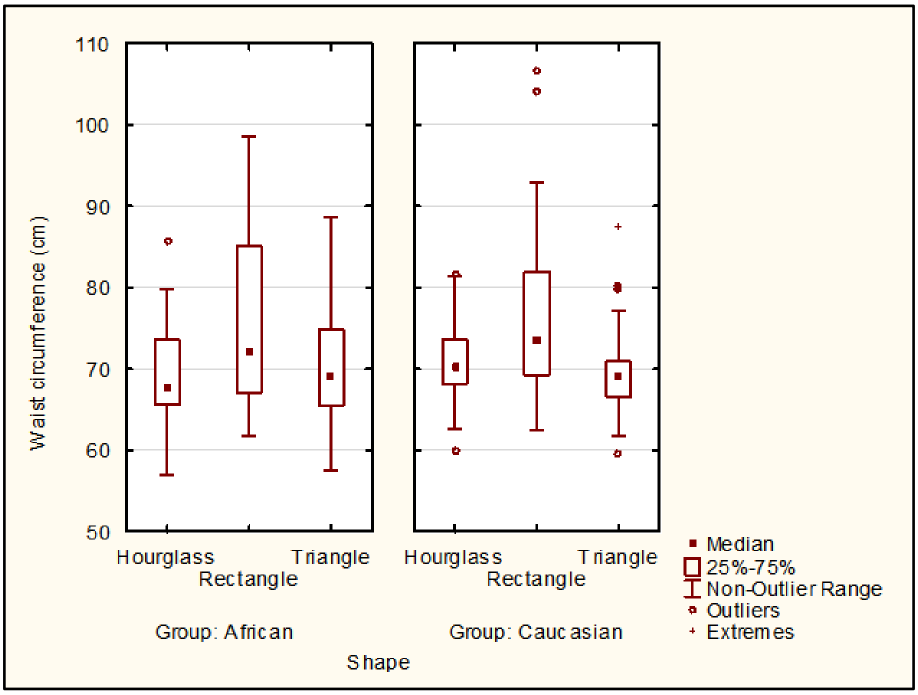
On the other hand, a pair-wise comparison of circumferential measurements of predominant Caucasian body shapes indicated significant differences in bust and waist circumferences only. Specifically, Caucasian triangular women had significantly smaller bust circumferences (86.5 cm) than the Caucasian hourglass (92.3 cm), and recorded a mean difference of 5.8 cm, as indicated by # in **Table 5.4**. This is visually illustrated in **Figure 5.6**. These differences confirm literature records that a smaller bust is a characteristic for triangular body shapes, and an average to fuller, rounded bust and narrower waist (than a rectangular shape), are characteristics of the hourglass shape (Rasband 1994:13; Rasband & Liechty, 2006:24).



Significant differences between Caucasian triangle and Caucasian hourglass, and between African triangle and Caucasian hourglass

FIGURE 5.6: COMPARISON OF BUST CIRCUMFERENCE OF AFRICAN AND CAUCASIAN BODY SHAPES

A comparison of the waist circumferences of the predominant Caucasian body shape pairs revealed a significant difference. Caucasian triangular shaped women had significantly smaller waist circumferences (69.0 cm) than Caucasian rectangular women (76.7 cm), with a mean difference of 7.7 cm, as indicated by * (**Table 5.4** and **Figure 5.7**). A wide midriff/waist that is almost equal to bust and hips are a characteristic of rectangular shapes, while triangular body shapes are characterised by a waist that is slightly wider than the bust yet narrower than the hips, without a waistline definition (Rasband & Liechty, 2006:25).



Significant difference between Caucasian triangle and Caucasian rectangle shapes

FIGURE 5.7: COMPARISON OF WAIST CIRCUMFERENCE OF AFRICAN AND CAUCASIAN BODY SHAPES

5.3.4 Comparison of significant differences in selected circumferential measurements of Caucasian hourglass and African body shapes

A comparison of the Caucasian hourglass and African triangle and African rectangle revealed that the African triangular shape had a significantly smaller bust and significantly larger hips, seat and thighs than the Caucasian hourglass, with mean differences of 4.6 cm, 6.2 cm, 4.8 cm and 4.3 cm respectively – all of which are indicated by * in **Table 5.4**. These differences confirm literature records (Rasband, 1994:12-13; Rasband & Liechty, 2006:24-25), which state that a triangular shape is characterised by a smaller bust and larger lower bodies, i.e. hips, seat, and thighs, whereas an hourglass shape has an average to large bust that is almost equal to the hips. Since the apparel industry bases apparel manufacturing on the Western or Caucasian hourglass figure, the differences in body shape characteristics are likely to have apparel fit implications especially for body shapes that differ significantly from the Caucasian or Western hourglass at key body parts.

5.3.5 Comparison of significant differences in selected width measurements of predominant African and Caucasian body shapes

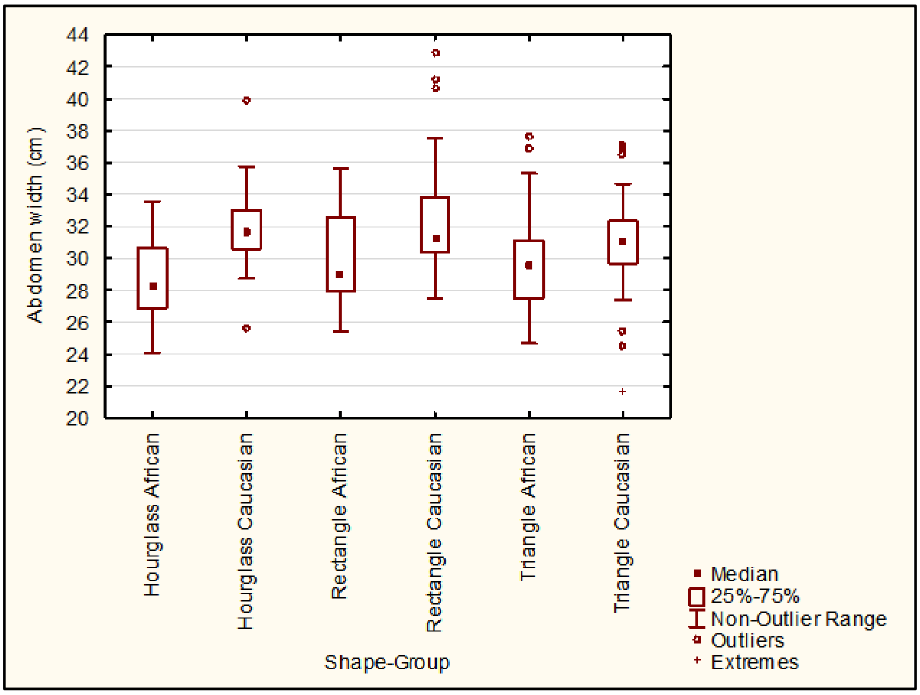
Width dimensions are calliper or straight horizontal distance measured from the right-hand side seam (trunk line) to the corresponding left-hand side seam at each level, i.e. at bust, stomach, waist, abdomen and hip levels. Comparison of width dimensions of all six body shapes recorded significant p-values on all the selected dimensions (**Table 5.5**).

Table 5.5 shows a comparison of width measurements of African and Caucasian body shape pairs. The findings from African and Caucasian women of the same shape revealed that Caucasian hourglass shapes had significantly wider abdomens than African hourglass shapes respectively (**Figure 5.8**). Specifically, the Caucasian hourglass had a significantly wider abdomen (31.8 cm) than the African hourglass by (28.6 cm) (as indicated by * in **Table 5.5**) even though both of these shapes are hourglass, they recorded a mean difference of 3.2 cm. This difference was also confirmed by visual comparisons, as discussed earlier. Both these differences show that ethnicity influences body shape characteristics.

TABLE 5.5: COMPARISON OF WIDTH MEASUREMENTS OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES

Dimension		African triangle	Caucasian triangle	African hourglass	Caucasian hourglass	African rectangle	Caucasian rectangle	Mean difference	Kruskal-Wallis p-value
Bust width	Mean (Standard deviation)	28.4 (2.02)	28.1 (1.73)	29.0 (2.62)	29.3 (2.01)	29.5 (2.94)	29.2 (3.01)	_	**0.0443****
	Median	28.2	28.0	28.2	29.5	28.9	28.6		
Stomach width	Mean (Standard deviation)	26.2 (2.02)	25.6 (1.62)	25.4 (1.50)	26.1 (1.80)	27.1 (2.21)	27.1 (3.32)	_	**0.0464****
	Median	26.0	25.4	25.3	25.8	26.7	26.3		
Waist width	Mean (Standard deviation)	25.1 (2.56)	25.6 (2.01)	24.3 (1.95)	25.5 (1.80)	25.4 (2.99)	28.0 (3.66)	2.5* 2.4#	**0.0000**
	Median	24.4	24.8	23.8	25.4	25.7	27.6		
	Significant difference		#		*		* #		
Abdomen width	Mean (Standard deviation)	29.8 (3.08)	31.0 (3.10)	28.6 (2.46)	31.8 (2.09)	29.9 (2.96)	32.6 (3.80)	2* 3.2#	**0.0000**
	Median	29.5	31.1	28.3	31.7	29.0	31.3		
	Significant difference	*		#	* #				
Hip width	Mean (Standard deviation)	39.7 (2.97)	39.4 (2.31)	37.6 (2.40)	37.8 (2.24)	38.0 (3.04)	38.2 (3.33)	1.9* 2.1#[1] 1.6#[2]	**0.0004**
	Median	39.4	39.2	37.7	38.0	38.4	38.1		
	Significant difference	* #[1]	#[2]	#[1]	#[2] *				

Bold p-values are statistically significant at 5%; *, #[1], #[2] indicates statistically different pairs, and ** significant difference may be above 5% or lie outside planned comparison in this study

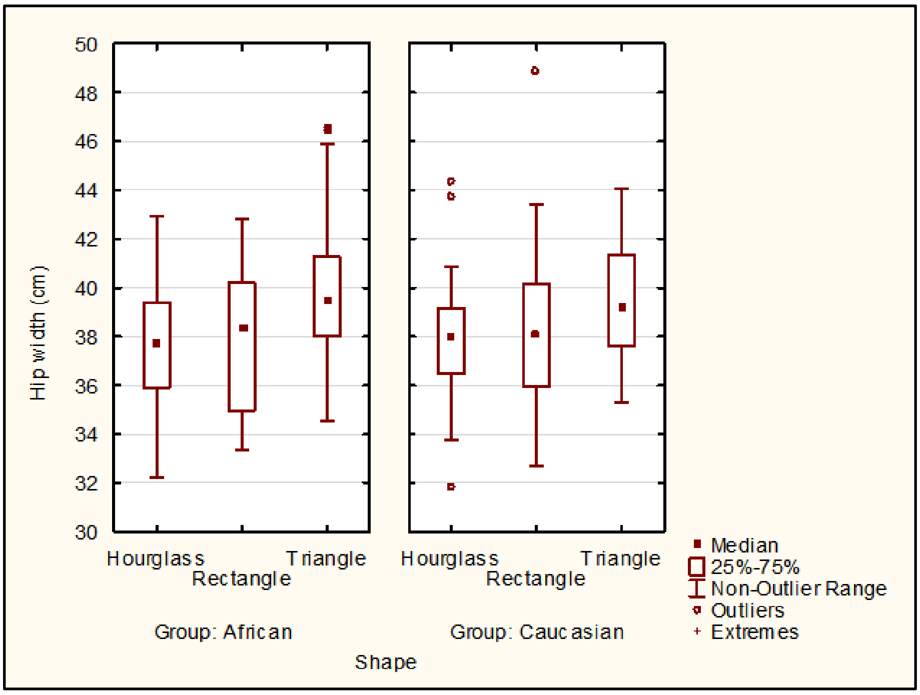


Significant differences between African triangle and Caucasian hourglass, and between African hourglass and Caucasian hourglass

FIGURE 5.8: COMPARISON OF ABDOMEN WIDTH OF AFRICAN AND CAUCASIAN BODY SHAPES

5.3.6 Comparison of significant differences in selected width dimensions of the three predominant African body shapes

Comparison of width dimensions of predominant African body shape pairs revealed that African triangular shapes recorded significantly wider hips than the African hourglass shape, as they recorded a mean difference of 2.1 cm, as indicated by #[1]. This difference is visually illustrated in **Figure 5.9** and was also observed from the visual and circumferential comparisons, where African triangular shape had wider hips than the African hourglass shape in **Table 5.4** and **Figure 5.3**. The African body shape pairs recorded no significant differences on all the other width measurements.

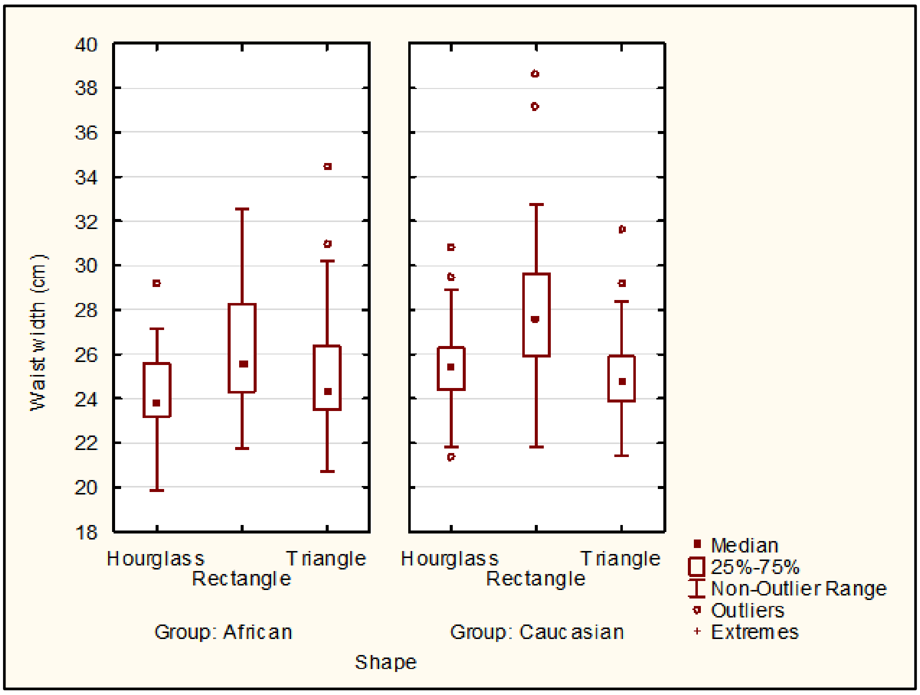


Significant difference between African triangle and African hourglass, between Caucasian triangle and Caucasian hourglass, and between African triangle and Caucasian hourglass

FIGURE 5.9: COMPARISON OF HIP WIDTH AFRICAN AND CAUCASIAN BODY SHAPES

5.3.7 Comparison of significant differences in selected width dimensions of predominant Caucasian body shapes

A comparison of width dimensions of Caucasian body shapes in **Figure 5.10** shows some significant differences. The waist width of the Caucasian rectangle was significantly wider than that of both the Caucasian hourglass and the Caucasian triangle, as they recorded mean differences of 2.5 cm and 2.4 cm respectively. These differences were also confirmed from visual comparison in **Figure 5.22**. However, it is worth noting that the Caucasian hourglass shape recorded no significant difference in waist circumference from the Caucasian rectangle. These body shape characteristics are recorded in the literature by for instance Rasband and Liechty (2006:25), who stated that the rectangular shape has a wider waist (midriff) than the triangular shape, whose waist is smaller with no indentation and the hourglass shape that has a narrower, indented waist.



Significant difference between Caucasian hourglass and Caucasian rectangle, and between Caucasian triangle and Caucasian rectangle shapes

FIGURE 5.10: COMPARISON OF WAIST WIDTH OF AFRICAN AND CAUCASIAN BODY SHAPES

The hips of Caucasian triangle (39.7 cm) were also significantly wider than those of the Caucasian hourglass (37.8 cm), as indicated by #[2] and as visually illustrated previously in **Figure 5.8**. These differences were in line with the literature (Rasband, 1994:12-13; Rasband & Liechty, 2006:24-25) that records that the triangular and hourglass shapes are characterised by wider hips and average to fuller rounder hips respectively.

5.3.8 Comparison of significant differences in selected width measurements of Caucasian hourglass and African triangle and rectangle

A comparison of the width dimensions of the Caucasian hourglass and the African triangle revealed that the African triangle had a significantly narrower abdomen (29.8 cm) than the Caucasian hourglass (31.8cm), and recorded mean differences of 2 cm as indicated by *. On the other hand, the Caucasian hourglass had significantly smaller hips than the African triangle, as they recorded hip width mean differences of 1.9 cm, as indicated by *. These differences are in line with literature records (Rasband, 1994:12-13; Rasband & Liechty, 2006:24-25), which state that the body of a triangular shape tapers from a small bust to wider abdomen and hips than hourglass, and is therefore prone to experience fit problems at the abdomen and hips (**Table 5.5**).

5.3.9 Comparison of significant differences in selected body protrusions in African and Caucasian body shapes

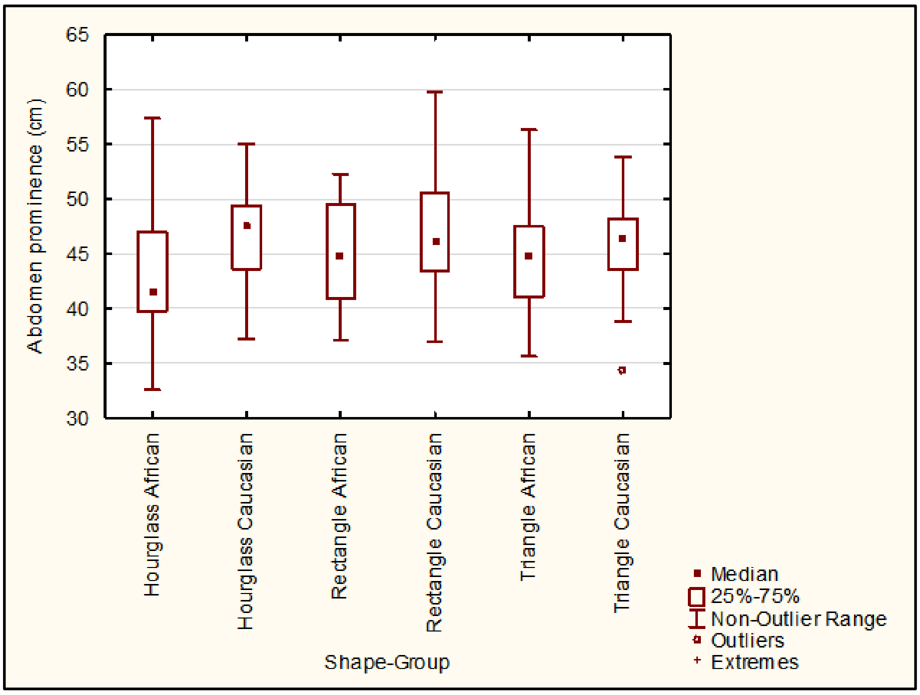
Body protrusions are measurements extracted from the right-hand side seam (trunk line), of the body over the fullest part to the corresponding left-hand side seam at each level (**Table 4.2** in **Chapter 4**). **Table 5.8** summarises the findings of the comparison of body front protrusions of African and Caucasian body shapes at the bust, stomach, waist levels as well as the back protrusion at back waist and seat/buttocks.

The bust front, waist front protrusions and waist back protrusions for similar African and Caucasian body shapes were almost equal as they recorded no significant differences ($p > 0.05$), except at the abdomen protrusion, as observed in **Table 5.6**. Caucasian hourglass shaped women had a significantly more prominent abdomen (46.3 cm) than African hourglass women (42.8 cm), and recorded mean differences of 3.5 cm as indicated by * **(Table 5.6).** The visual as well as abdomen circumference and abdomen width of the Caucasian hourglass were also significantly wider than those of the African hourglass, as illustrated in **Figure 5.23**. **Figure 5.11** illustrates a visual presentation of the differences in the abdomen protrusions. The differences indicate that, although both the African hourglass and the Caucasian hourglass shapes are classified as hourglass, the Caucasian hourglass shape had a distinctively more prominent abdomen than the African hourglass shape (**Figure 5.11)**.

TABLE 5.6: COMPARISON OF BODY PROTRUSIONS OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES

Dimension		African triangle	Caucasian triangle	African hourglass	Caucasian hourglass	African rectangle	Caucasian rectangle	Mean differences	Kruskal-Wallis p-value
Bust front/protrusion	Mean (Standard deviation)	46.6 (5.06)	45.5 (3.35)	48.6 (4.79)	49.3 (3.72)	48.6 (5.96)	48.6 (5.65)	2.7* 3.8#	**0.0002**
	Median	46.0	45.6	48.6	49.1	47.3	47.4		
	Significant difference	*	#		* #				
Stomach front/protrusion	Mean (Standard deviation)	37.2 (5.56))	35.0 (3.02)	35.8 (3.95)	36.7 (3.79)	39.4 (5.38)	36.9 (4.56)	_	**0.0461****
	Median	36.5	34.4	34.8	36.1	39.3	35.8		
Waist front/protrusion	Mean (Standard deviation)	34.0 (3.39)	33.8 (3.28)	32.5 (3.09)	34.6 (2.88)	36.6 (5.12)	37.9 (6.29)	4.1#	**0.0008**
	Median	33.2	33.3	32.5	33.8	34.9	36.1		
	Significant difference		#				#		
Abdomen front/protrusion	Mean (Standard deviation)	44.8 (4.76)	45.9 (4.22)	42.8 (5.50)	46.3 (4.45)	44.7 (4.81)	47.0 (5.72)	3.5*	**0.0102**
	Median	44.8	46.4	41.5	47.4	44.8	46.0		
	Significant difference			*	*				
Waist back/ extension	Mean (Standard deviation)	36.6 (3.65)	36.0 (2.42)	35.9 (3.10)	37.0 (2.61)	39.2 (5.33)	39.7 (4.68)	3.7#	**0.0005**
	Median	35.8	35.9	34.9	36.4	37.3	38.9		
	Significant difference		#				#		
Seat back/ extension	Mean (Standard deviation)	50.6 (5.14)	48.7 (3.09)	48.0 (4.49)	47.6 (2.74)	49.5 (5.92)	48.8 (5.18)	-	0.0515
	Median	49.2	48.1	47.2	47.7	50.7	47.1		

Bold p-values are statistically significant at 5%; *, # indicate statistically different pairs, and ** significant difference may be above 5% or lie outside planned comparison in this study



Significant difference between African hourglass and Caucasian hourglass shapes

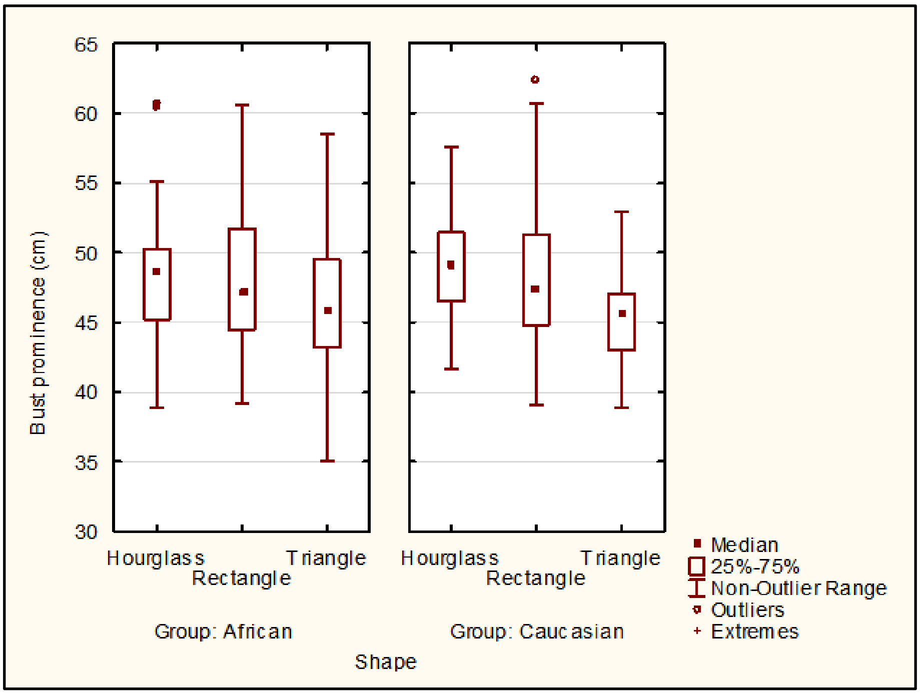
FIGURE 5.11: COMPARISON OF ABDOMEN PROMINENCE AFRICAN AND CAUCASIAN BODY SHAPES

5.3.10 Comparison of significant differences in selected body protrusions of the three predominant African body shapes

A comparison of predominant African body shape pairs revealed slight differences in all the key body protrusions, which were statistically significant (**Table 5.6**). Visual comparison in **Figure 5.24** shows that African triangular shapes had a more prominent seat than the African rectangular and African hourglass shapes, all of which confirm literature records (Rasband, 1994:12-13). However, these differences could not be confirmed from measurements as they recorded no significant differences. Furthermore, the African hourglass shape had a more prominent bust than both the triangular and rectangular shapes. Rectangular shapes had a more prominent stomach, waist and abdomen than the hourglass and triangular shapes, which confirms literature records (Rasband, 1994:12-13). These differences too, could not be confirmed from measurements as they recorded no significant differences.

5.3.11 Comparison of significant differences in selected body protrusions of predominant Caucasian body shapes

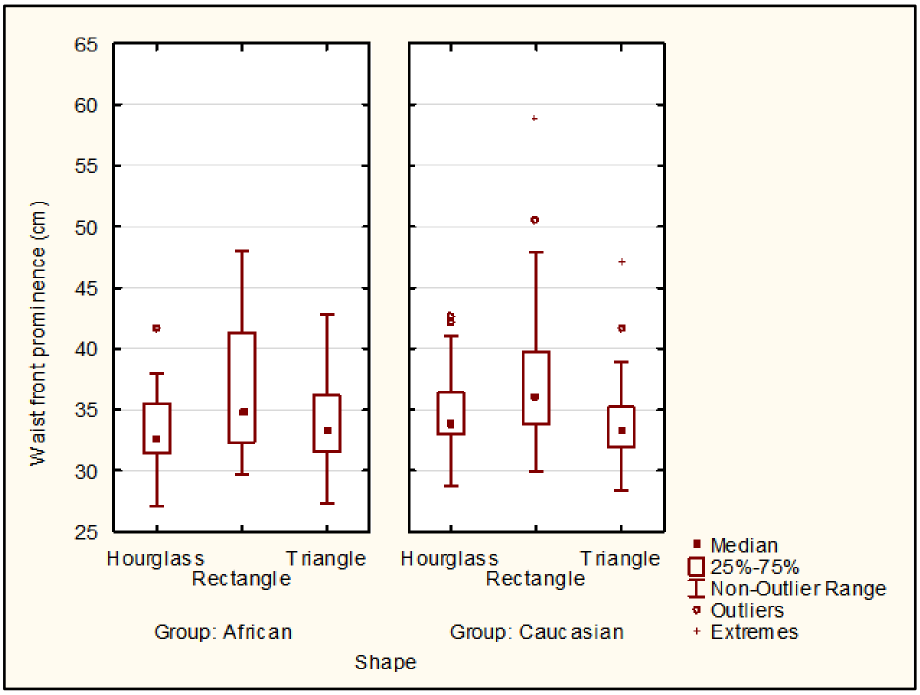
When the body protrusion of the three predominant Caucasian body shape pairs were compared, it was evident that Caucasian triangular shaped women had a significantly less prominent bust than the Caucasian hourglass, as they recorded a mean difference of 3.8 cm as indicated by #. Caucasian triangular shaped women had bust prominence measurements of 45.6 cm, whereas the Caucasian hourglass had a bust protrusion of 49.3 cm (**Table 5.6** and **Figure 5.12**).



Significant difference between African triangle and Caucasian hourglass, and between Caucasian hourglass and Caucasian triangle shapes

FIGURE 5.12: COMPARISON OF BUST PROMINENCE OF AFRICAN AND CAUCASIAN BODY SHAPES

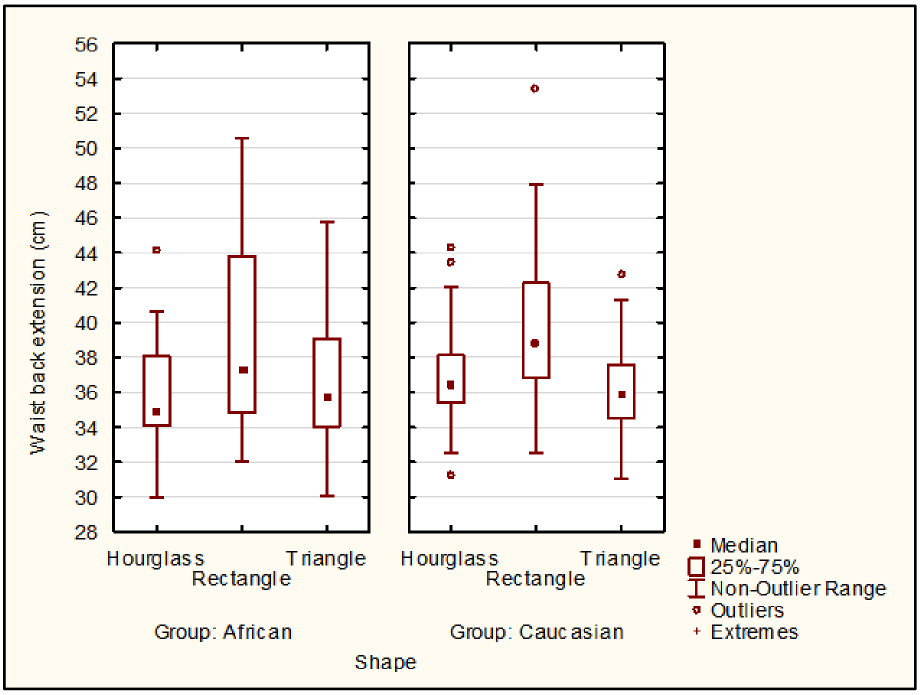
Furthermore, a comparison of waist front protrusion of predominant Caucasian body shape pairs recorded significant differences. These differences indicated that Caucasian rectangle shaped women had a significantly more prominent waist front (37.9 cm) than Caucasian triangular women (33.8 cm), and recorded a mean difference of 4.1cm as indicated by # (**Table 5.6** and **Figure 5.12)**. The literature also confirms these differences, stating that rectangular shapes have a larger midriff/waist with no defined waistline, whereas triangular shapes have a medium to wide waist that is proportionately smaller than the hips in terms of circumference (Rasband, 1994:12-13; Rasband & Liechty, 2006:25). These differences were also confirmed in the visual comparison of the waist front of Caucasian triangle and Caucasian rectangle in **Figure 5.25**. These findings confirm that not only is the waist circumference of Caucasian rectangular shapes larger, their waist front is also more prominent than that of the Caucasian triangular shape. Visual representation of the different waist front protrusions of the body shapes is further visually illustrated in **Figure 5.13**.



Significant difference between Caucasian triangle and Caucasian rectangle

FIGURE 5.13: COMPARISON OF WAIST FRONT PROMINENCE OF AFRICAN AND CAUCASIAN BODY SHAPES

The waist back extension (waist back curvature) is a calliper measurement extracted at the smallest waist from the centre front to the centre back. **Figure 5.14** is a visual representation of differences in waist back curvatures of the different body shapes. The Caucasian triangular and Caucasian rectangular shapes recorded a significant difference in waist back extension measurement. The Caucasian triangle had significantly smaller waist back extensions (36.0 cm) than Caucasian rectangular shapes (39.7 cm). A smaller waist back extension for the Caucasian triangle indicates a deep waist curvature. On the other hand, a larger waist back extension measurement of the Caucasian rectangular shape is indicative of a shallow waist back curvature. This means that Caucasian triangular shapes had deeper waist back curvature than Caucasian rectangular women. These differences were also observed visually and also confirmed literature which states that triangular shaped women have smaller waist than rectangular shapes (Rasband, 1994:12-13; Rasband & Liechty, 2006:24-25).



Significant difference between Caucasian triangle and Caucasian rectangle shapes

FIGURE 5.14: COMPARISON OF WAIST BACK PROTRUSION OF AFRICAN AND CAUCASIAN BODY SHAPES

5.3.12 Comparison of significant differences in selected body protrusions of African body shapes to Caucasian hourglass

A comparison of body protrusions of the Caucasian hourglass and African triangle and African rectangle revealed that African triangular shapes had a significantly less prominent bust than the Caucasian hourglass. According to literature (Rasband, 1994:12-13; Rasband & Liechty, 2006:24-25), triangular shapes are characterised by smaller/less prominent bust than hourglass shapes, which are characterised by average to large bust. Triangular shapes are therefore expected to experience apparel fit problems at the bust from apparel manufactured based on shape and dimensions of a Western (Caucasian) hourglass.

5.3.13 Comparison of significant differences in selected height dimensions of African and Caucasian body shapes

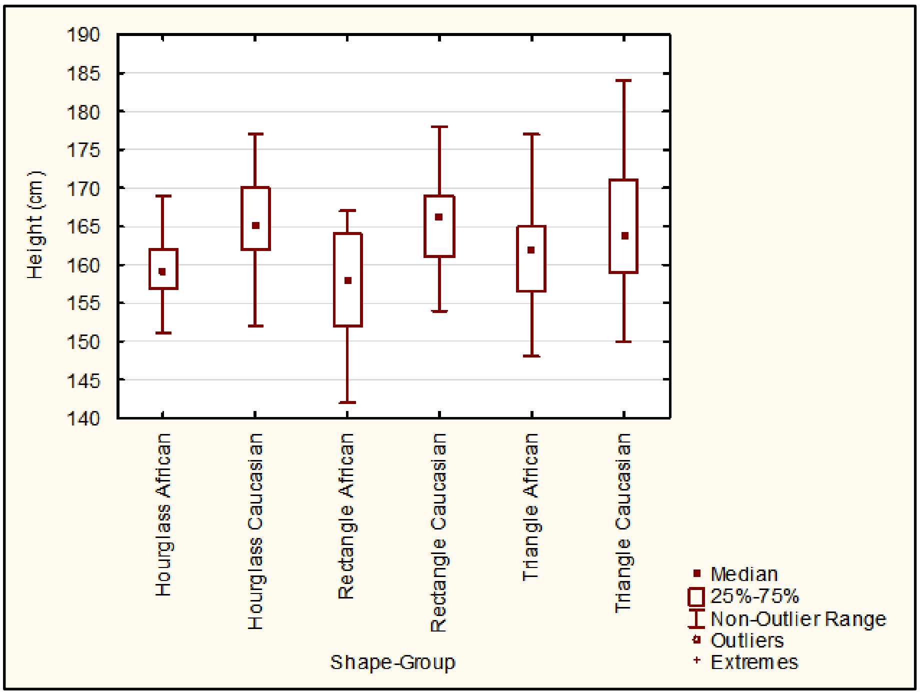
The height dimensions used in this study were the vertical distance from the floor to the different key height levels on the 3-D body scan images (**Table 4.2** in **Chapter 4**). For instance, bust height was the vertical distance from the floor to the bust point level. Key height dimensions of interest in this study are: total body, bust, waist, hip and knee heights. The Kruskal-Wallis test was again used to determine significant differences in height measurements of the predominant body shape categories. Height dimensions with significant p-values, i.e. p-values less than alpha (significance) level of 0.05 were further subjected to pair-wise comparisons. This was to determine African and Caucasian body shape pairs with significantly different height dimensions. **Table 5.7** below shows that a comparison of similar body shapes recorded significant differences in total body, bust and waist height dimensions.

TABLE 5.7: COMPARISON OF HEIGHT DIMENSIONS OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES

Dimension		African triangle	Caucasian triangle	African hourglass	Caucasian hourglass	African rectangle	Caucasian rectangle	Mean differences	Kruskal-Wallis p-value
Total body height	Mean (Standard deviation)	161.0 (6.13)	164.6 (7.56)	159.6 (4.45)	165.8 (5.61)	157.4 (7.63)	165.4 (6.14)	4.8* 6.2#1 8.4#2 8#3	**0.0000**
	Median	162.0	164.0	159.0	165.0	158.0	166.0		
	Significant difference	*		#1	* #1 #2	#2 #3	#3		
Bust height	Mean (Standard deviation)	116 (5.19)	118.6 (5.69)	115.6 (3.74)	120.4 (4.68)	113.7 (6.68)	118.3 (5.30)	4.4* 4.8#1 6.7#2	**0.0001**
	Median	117.6	116.7	115.6	119.9	114.9	119.2		
	Significant difference	*		#1	* #1 #2	#2			
Waist Height	Mean (Standard deviation)	104.3 (4.83)	104.4 (6.34)	102.5 (3.58)	106.0 (4.65)	100.9 (5.94)	103.2 (6.59)	3.5*	**0.0087**
	Median	104.70	103.7	102.3	106.0	101.2	103.2		
	Significant difference			*	*				
Hip height	Mean (Standard deviation)	78.0 (4.41)	77.4 (5.12)	77.0 (3.55)	78.6 (4.45)	76.2 (6.14)	78.1 (4.35)	–	0.4615
	Median	78.3	76.5)	76.6	78.7	76.5	77.4		
Knee height	Mean (Standard deviation)	45.4 (3.2)	45.6 (3.33)	45.8 (3.35.4)	46.0 (3.06)	45.0 (5.29)	45.5 (3.32)	–	0.6201
	Median	45.3	45.0	44.9	45.9	44.7	45.3		

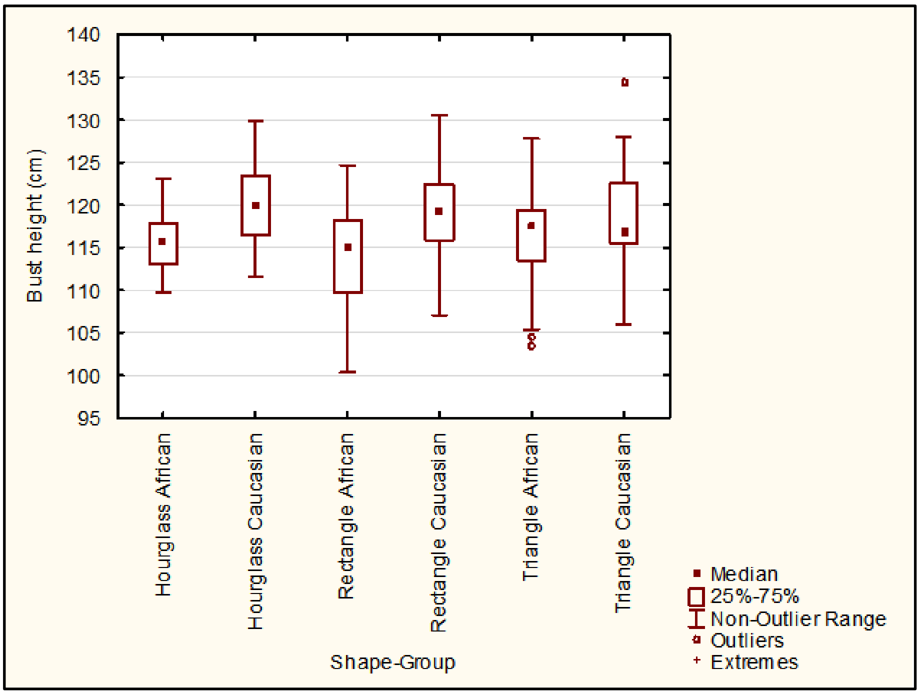
Bold p-values are statistically significant at 5%; *, #1, #2, #3 indicate statistically different pairs

Box plots representing these differences are illustrated in **Figure 5.15** for total body height, **Figure 5.16** for bust height, and **Figure 5.17** for waist height. Specifically, Caucasian hourglass shaped women recorded significantly higher mean total body height, bust height and waist height dimensions than African hourglass shaped women. The Caucasian hourglass recorded 165.8 cm for mean total body height, 120.4 cm for bust height and 106.0 cm waist height dimensions, compared to the African hourglass shaped women who recorded 159.6 cm, 115.6 cm and 102.5 cm respectively. The differences highlighted above indicate that Caucasian hourglass shaped women had taller torsos than African hourglass shaped women. This was also confirmed by hip and knee height dimensions of African and Caucasian hourglass, which recorded no significant differences ($p > 0.05$).



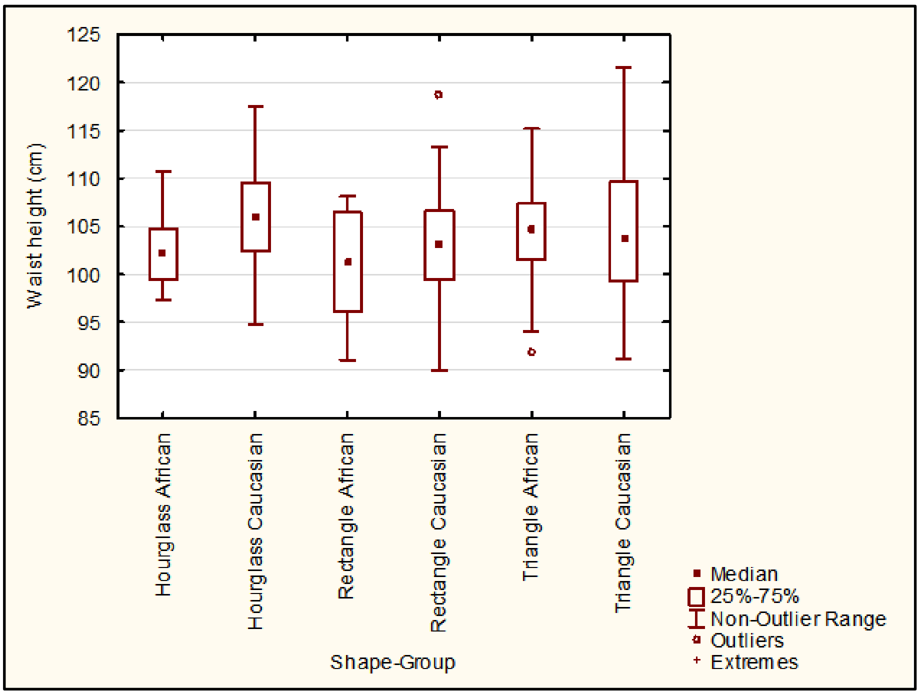
Significant difference between African triangle and Caucasian hourglass, between African hourglass and Caucasian hourglass, between African rectangle and Caucasian hourglass, and between African rectangle and Caucasian rectangle

FIGURE 5.15: COMPARISON OF TOTAL BODY HEIGHT OF AFRICAN AND CAUCASIAN BODY SHAPES



Significant difference between African triangle and Caucasian hourglass, between African hourglass and Caucasian hourglass, and between African rectangle and Caucasian hourglass

FIGURE 5.16: COMPARISON OF BUST HEIGHT OF AFRICAN AND CAUCASIAN BODY SHAPES



Significant difference between African hourglass and Caucasian hourglass

FIGURE 5.17: COMPARISON OF WAIST HEIGHT OF AFRICAN AND CAUCASIAN BODY SHAPES

Furthermore, height dimensions of the three predominant African and predominant Caucasian body shapes were compared; these paired comparisons showed no significant differences in all the key height dimensions, as illustrated in **Table 5.7**. There were no visual comparisons for height dimensions, as explained earlier.

5.3.14 Comparison of significant differences in selected height measurements of African body shapes to Caucasian hourglass

The findings of the comparisons of height dimensions revealed that Caucasian women were taller than African women. This was also evident as Caucasian hourglass shapes recorded significantly higher total body height and bust heights than both African triangular and African rectangular shapes. As a result, African triangular and African rectangular shaped women are prone to experience apparel fit problems due to the lower bust height resulting in bust line details like darts of standard apparel being higher.

5.3.15 Comparison of significant differences in selected circumferential ratios of African and Caucasian body shapes

The Kruskal-Wallis test was again used to further investigate how key circumferential and height ratios of predominant African and Caucasian body shape pairs relate to each other. The ratios of interest in this study are relationships of the bust to waist, hip to waist and bust to hip circumferences, as well as total body to bust height, total body to waist height, total body to hip height, and total body to knee height. The pair-wise comparisons of key circumferential ratios of predominant African and Caucasian body shapes are important as variation in measurements and ratios of participants within and across ethnic groups impacts on RTW apparel fit. The Kruskal-Wallis test was again used to determine whether there were significant differences in circumferential and height ratios of predominant African and Caucasian body shapes. Significant p-values ($p < 0.05$) were further subjected to pair-wise comparisons to determine which of the three predominant African and Caucasian body shape pairs were significantly different. The pair-wise comparison of circumferential and height ratios of African and Caucasian women of the same predominant body shapes revealed no significant differences in total body to bust height, nor in total body to knee height ratios.

Table 5.8 shows that only African hourglass and Caucasian hourglass shapes recorded significantly different hip to waist circumferential ratios. The African hourglass had significantly higher hip to waist ratios (1.43) than the Caucasian hourglass (1.41)

TABLE 5.8: COMPARISON OF CIRCUMFERENTIAL RATIOS OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES

Ratios		**African triangle**	**Caucasian triangle**	**African hourglass**	**Caucasian hourglass**	**African rectangle**	**Caucasian rectangle**	**Mean differences**	**Kruskal-Wallis p-value**
Bust to Waist circumference	Mean (Standard deviation)	1.25 (0.05)	1.25 (0.06)	1.31 (0.04)	1.30 (0.04)	1.22 (0.04)	1.19 (0.06)	0.05*#2 , 0.06#1#3, 0.09#4, 0.08#5, 0.11#6	**0.0000**
	Median	1.25	1.26	1.30	1.29	1.22	1.21		
	Significant difference	* #1	#2 #3	#1#4	* #2 #5 #6	#4 #5	#3 #6		
Hip to Waist circumference	Mean (Standard deviation)	1.51 (0.08)	1.49 (0.08)	1.43 (0.06)	1.41 (0.06)	1.34 (0.08)	1.32 (0.08)	0.1*, 0.08#1#3, 0.17#2 #4, 0.09#5	**0.0000**
	Median	1.50	1.50	1.42	1.41	1.36	1.34		
	Significant difference	* #1 #2	#3 #4	#1	* #3 #5	#2	#4 #5		
Bust to Hip circumference	Mean (Standard deviation)	0.82 (0.03)	0.84 (0.03)	0.91 (0.03)	0.92 (0.03)	0.91 (0.03)	0.90 (0.03)	0.1*, 0.09#1#2, 0.08#3, 0.06#4	**0.0000**
	Median	0.84	0.85	0.91	0.92	0.89	0.90		
	Significant difference	* #1 #2	#3 #4	#1	* #3	#2	#4		

Bold p-values are statistically significant at 5%; *, #1, #2, #3, #4, #5, #6 indicate statistically different pairs

5.3.16 Comparison of significant differences in selected circumferential ratios of the three predominant African body shapes

The circumferential ratios of predominant African and Caucasian body shapes were compared. **Table 5.8** illustrates that all the key circumferential ratios recorded significant differences, namely: bust to waist, hip to waist, and bust to hip. A comparison of the circumferential ratios of predominant African body shape pairs indicated that African hourglass shaped women had significantly higher bust to waist ratio (1.31) than those of both the African triangle and (1.25) the African rectangle (1.22). On the other hand, the African triangle recorded a significantly higher (1.51) hip to waist ratio than both the African hourglass (1.43) and the African rectangular shape (1.34). Due to the characteristic of wider hips, triangular shaped women recorded significantly lower bust to hip ratio (0.82) than both the African hourglass and the African rectangle, who recorded 0.91 (**Table 5.8**). It should be noted that a bust to hip ratio close to 1 as it was observed among hourglass and rectangular shapes, is an indication that the bust and hip circumferences are almost equal (Rasband 1994:12-13; Rasband & Liechty, 2006:24-25). The smallest bust to hip ratio of the triangular shapes shows that the hips were larger than the bust. These ratios confirm literature records that triangular shapes have wider hip and smaller bust circumferences; hence, the lower bust to waist ratios recorded by triangular shapes (Rasband 1994:12-13; Rasband & Liechty, 2006:24-25).

5.3.17 Comparison of significant differences in selected circumferential measurement ratios of predominant Caucasian body shape

A comparison of the predominant Caucasian body shape pairs indicates that Caucasian triangular shaped women had a significantly higher bust to waist circumferential ratio (1.25) than the Caucasian rectangle (1.19) and lower than the Caucasian hourglass (1.30) – see **Table 5.8.** The Caucasian triangle recorded a significantly higher hip to waist circumferential ratio (1.49) than both the Caucasian hourglass (1.41) and the Caucasian rectangle (1.32). On the other hand, the Caucasian rectangle also recorded a significantly lower hip to waist ratio than the Caucasian hourglass. The bust to hip ratios of the Caucasian triangle was significantly lower (0.84) than those of the Caucasian hourglass (0.92) and the Caucasian rectangle (0.90). This is because hourglass shaped women had a wider bust circumference and a narrower waist circumference, whereas triangular shaped women had a smaller bust circumference and a slightly wider waist than the bust circumferences. These resulted in triangular shapes recording lower bust to waist ratios than hourglass shaped women. On the other hand, rectangular shaped women had significantly lower bust to waist ratios than hourglass shaped women, due to their bust and waist circumferences that were almost equal (Rasband, 1994:12-13; Rasband & Liechty, 2006:24-25).

5.3.18 Comparison of significant differences in selected circumferential measurement ratios of African body shapes to Caucasian hourglass

The circumferential ratios of the Caucasian hourglass and African triangle as well as the African rectangle were compared. These findings indicate that the Caucasian hourglass had a higher (1.30) bust to waist circumferential ratio than both the African triangle (1.25) and the African rectangle (1.19). This emanates from the smaller bust of the African triangular shape than its waist, and the fact that the African rectangle had a bust and a waist that were almost equal – hence their lower bust to waist ratios than the Caucasian hourglass. The Caucasian hourglass also had an average to large bust and a very small waist, which resulted in the higher bust to waist ratio. Due to the larger hips than waist, the African triangle had a higher hip to waist ratio than the Caucasian hourglass, as they recorded 1.51 and 1.41 circumferential ratios respectively. On the other hand, the Caucasian hourglass had a higher bust to hip ratio which was closer to 1 (0.92) and higher than that of the African triangle (0.82). This indicates that the Caucasian hourglass had bust and hips that were almost equal (hence bust to hips ratio close to 1), compared to the African triangle whose hips are larger than the bust, thus giving a lower ratio. The differences in ratios outlined above confirm the significant differences in circumferential measurements as presented in **Table 5.4**, which are also clearly visible in the scanned body images.

5.3.19 Comparison of significant differences in selected height measurement ratios of African and Caucasian body shapes

A comparison of the height ratios of similar African and Caucasian body shapes revealed significant differences in total body to waist height and total body to hip height ratios. The Caucasian rectangular and African rectangular shapes recorded significantly different total body to waist height ratios. More specifically, the Caucasian rectangle had significantly higher (1.61) total body to waist heights than the African rectangle (1.56). The Caucasian triangle also recorded a higher total body to waist height ratio (1.58) than the African triangle (1.55). Furthermore, the Caucasian triangle also recorded a higher total body to hip height (2.13) than the African triangular shape (2.07) (**Table 5.9**). This confirms the findings from height measurements which revealed that the Caucasian triangle, hourglass and rectangle were taller and therefore recorded higher height dimensions and height measurement ratios than their African counterparts.

TABLE 5.9: COMPARISON OF HEIGHT RATIOS OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES

Ratios		African triangle	Caucasian triangle	African hourglass	Caucasian hourglass	African rectangle	Caucasian rectangle	Mean difference	Kruskal-Wallis p-value
Total body to bust height	Mean (Standard deviation)	1.39 (0.03)	1.39 (0.02)	1.38 (0.03)	1.38 (0.03)	1.39 (0.04)	1.40 (0.03)	–	0.0676
	Median	1.38	1.39	1.39	1.38	1.40	1.39		
Total body to waist height	Mean (Standard deviation)	1.55 (0.04)	1.58 (0.05)	1.55 (0.03)	1.57 (0.05)	1.56 (0.03)	1.61 (0.07)	0.04* 0.03#[1] 0.05#[2]	**0.0000**
	Median	1.54	1.58	1.55	1.56	1.55	1.61		
	Significant difference	#[1]	#[1]		*	#[2]	* #[2]		
Total body to hip height	Mean (Standard deviation)	2.07 (0.07)	2.13 (0.06)	2.08 (0.07)	2.11 (0.07)	2.07 (0.09)	2.12 (0.07)	0.04* 0.06#	**0.0001**
	Median	2.07	2.13	2.08	2.11	2.08	2.10		
	Significant difference	* #	#		*				
Total body to knee height	Mean (Standard deviation)	3.57 (0.21)	3.61 (0.15)	3.50 (0.23)	3.62 (0.21)	3.53 (0.28)	3.65 (0.22)	–	**0.0312****
	Median	3.58	3.63	3.55	3.61	3.54	3.67		

Bold p-values are statistically significant at 5%; *, #[1], #[2] indicate statistically different pairs, and ** significant difference may be above 5% or lie outside planned comparison in this study

5.3.20 Comparison of significant differences in selected height measurement ratios of predominant African body shapes

A comparison of all the height measurement ratios of predominant African body shape pairs indicated no significant differences. The findings from the comparison of the height dimensions of the three predominant African body shapes also show that the African body shapes were almost the same height, since their height dimensions did not differ significantly.

5.3.21 Comparison of significant differences in selected height measurement ratios of predominant Caucasian body shapes

When the height dimension ratios of the predominant Caucasian body shapes were compared, most of the paired body shapes recorded no significant differences, except the total body to waist height ratio, where the Caucasian rectangular shape recorded a significantly higher (1.61) ratio than the Caucasian hourglass (1.57) (**Table 5.9**). However, a comparison of the total body and waist height measurements of the Caucasian rectangle and Caucasian hourglass did not differ significantly.

5.3.22 Comparison of significant differences in selected height measurement ratios of African body shapes to the Caucasian hourglass

The height dimension ratios of the Caucasian hourglass were compared to those of the African triangle as well as those of the African rectangle. As mentioned earlier, the Caucasian body shapes were taller than the African body shapes. As a result, the Caucasian hourglass shape also had a significantly higher total body to hip height ratio (2.11) than the African triangle (2.07). Since the RTW apparel industry uses the Western/ Caucasian hourglass as a base for designs, this difference may result in the African body shapes experiencing apparel fit problems around the hip. For example, hip details are likely to be higher on the African women than on an average figure.

5.4 VISUAL COMPARISON OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES (OBJECTIVE 2, SUB-OBJECTIVE 2.1)

This study further analysed and compared the scan images of the predominant body shapes. The scan images selected to represent each body shape in this chapter were of those participants who best represented each body shape, i.e. participants with key body measurements that were average or closest to average. Presented in this study are visual assessment and comparison of scan images' key widths (from the front view) and body protrusions (from the side view) of the three predominant African and Caucasian body shapes. It should be noted that scan images are two-dimensional and show only the front and side views of the participants' bodies. Therefore, visual analyses and comparisons of circumferential measurements are not included as they are two-dimensional. There were also no visual analysis and comparison of participants' height dimensions since the total body height was taken manually. Moreover, the 3-D body scanner could not accurately locate the crowns of participants' heads due to obstruction from their hair. Furthermore, even though the other key height measurements, namely: bust, waist, hip and knee heights, were electronically extracted, the scan images were not in the participants' actual body height/sizes nor were scale or ratios of the scan images to the actual height measurements of the participants indicated.

5.4.1 Visual comparison of front view images of the African and Caucasian triangle shape

The front views of the scan images were visually assessed to determine the relationship between key body widths, namely the bust, stomach, waist, abdomen, hips and thighs. This analysis shows that average African and Caucasian triangular shaped women had a medium and small bust respectively. Both African and Caucasian triangles had a smaller waist with no indentation and their bodies tapered from the stomach to the hips. However, the Caucasian triangle showed a wide pelvic area that bulged below the waist to the upper hip, thus making their abdomen width appear wider than that of the African triangle. The hips of an average Caucasian triangular woman were moderately round and the thighs had a moderate bulge, compared to those of an average African triangular shape, whose hips were fully round and wider and the thighs were also larger (**Figure 5.18**). It should be noted that even though there were differences in visual assessments of the African and Caucasian triangle shapes as outlined above, the width and circumferential dimensions recorded no significant differences, except that the African triangle had significantly larger thighs than the Caucasian triangle.

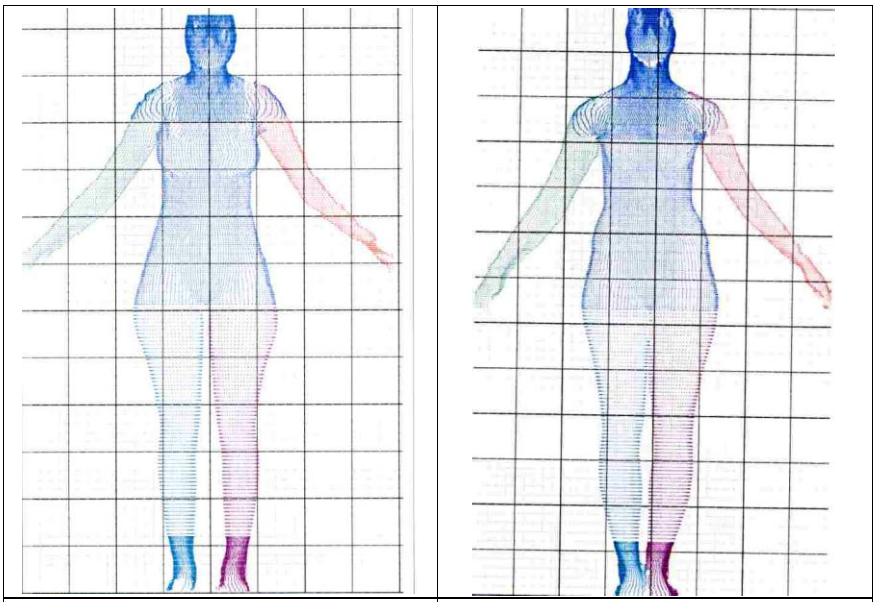


FIGURE 5.18: VISUAL COMPARISON OF AFRICAN AND CAUCASIAN TRIANGULAR SHAPES

5.4.2 Visual comparison of front width images of the African and Caucasian hourglass shape

The front view analysis of both hourglass shapes shows that the African and Caucasian had bust and hips wider than the waist (**Figure 5.19**). This confirms the findings from the measurements, where the African and Caucasian hourglass's waist was narrower than both the bust and hips. The average African hourglass had a larger bust than the Caucasian hourglass, and they both had moderately round hips. The Caucasian hourglass also showed a narrower waist than an average African hourglass. The front view of an average Caucasian hourglass showed a small bulge at the pelvic area below the waist to the upper hip, making the abdomen area look wider than that of an African hourglass. The hips of the average African and Caucasian hourglass shapes were moderately rounded, except that the hips of the African hourglass appeared to be bulging slightly more and rounder than those of the Caucasian hourglass. This difference was confirmed from width and circumferential measurements, as the Caucasian hourglass had a significantly wider abdomen than the African hourglass, as reflected in **Tables 5.4** and **5.5** respectively. However, the visual differences in the hip width of the African and Caucasian hourglass could not be confirmed from measurements, as their hip width and hip circumferences recorded no significant differences.

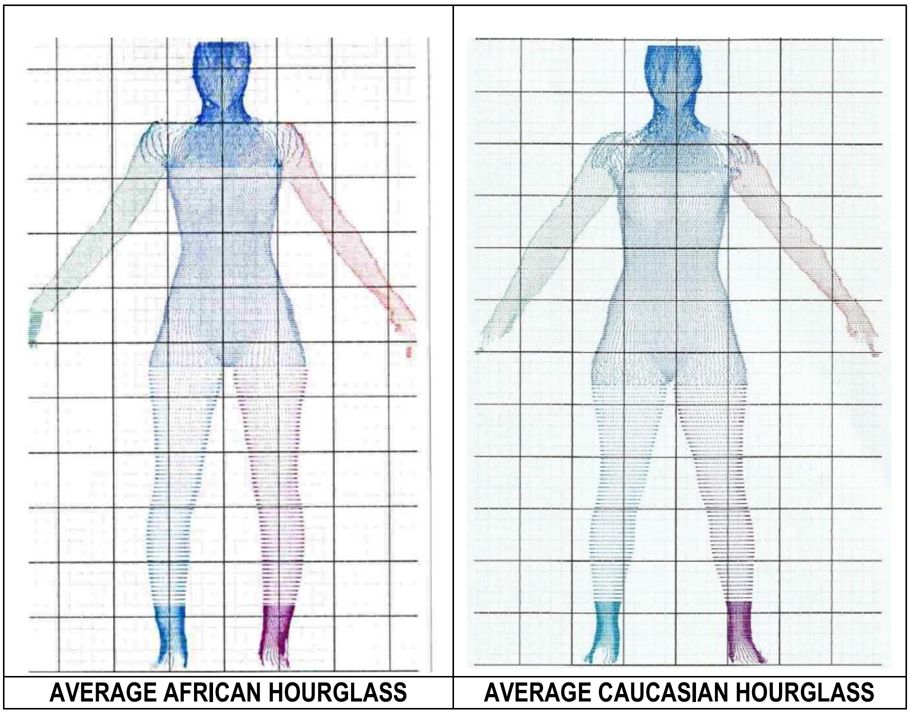


FIGURE 5.19: VISUAL COMPARISON OF AFRICAN AND CAUCASIAN HOURGLASS SHAPE

5.4.3 Visual comparison of front view images of the African and Caucasian rectangular shape

As explained earlier, a rectangular shape has bust and hips that are almost equal, with little or no indentation at the waist (Rasband & Liechty, 2006:25). In this study a body classified as a rectangular shape had parameters 5.6 cm < bust and waist < 18 cm, which show a small difference between bust and waist circumferences, especially on the lowest cut-off point (5.6 cm drop). These parameters were confirmed, since the front view analysis of both the African and the Caucasian rectangular shapes showed that the bust and hips were almost equal and the waist was slightly smaller, with no indentation. The abdomen area of the Caucasian rectangle appeared wider than that of the African rectangular due to their high pelvic bone, as explained earlier. The hips of both rectangular shapes appeared to be medium; however, those of the African rectangular shape were slightly rounder compared to those of the Caucasian rectangular shape, which were more flat/straight (**Figure 5:20**). This was a characteristic that was also observed by Mastamet-Mason where Kenyan rectangular shaped women were curvy compared to the USA rectangle, which was straight. It was clear from the visual assessment of the scan images that African and Caucasian participants with the same body shapes had measurements with differences at key body parts, some of which could only be confirmed visually and were not detected from measurements.

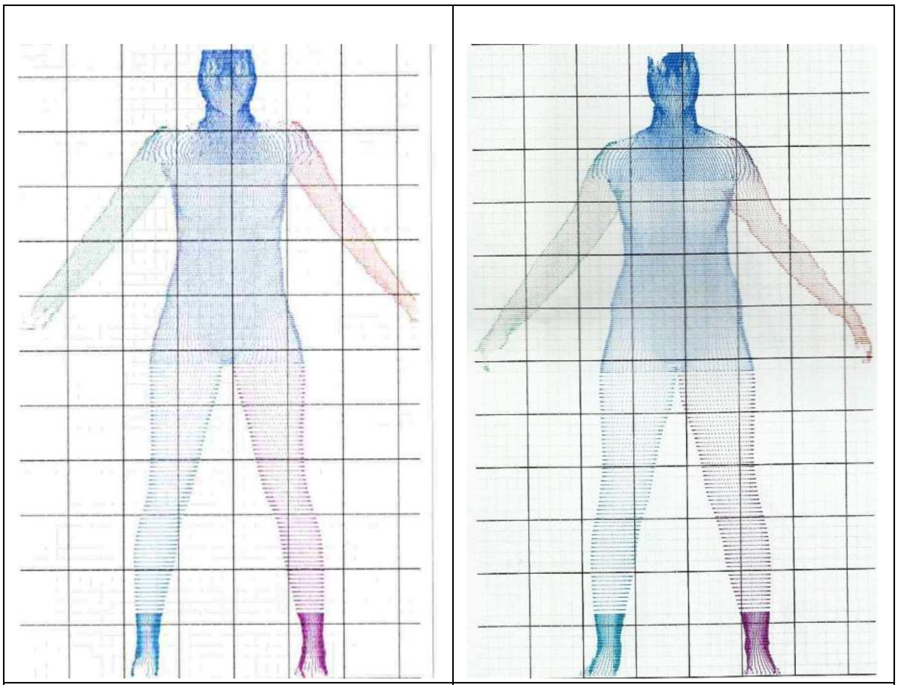


FIGURE 5.20: VISUAL COMPARISON OF AFRICAN AND CAUCASIAN RECTANGULAR SHAPE

5.4.4 Visual comparison of front view images of the three predominant African body shapes

The front view of scan images of the predominant African body shapes were visually analysed and compared. **Figure 5.21** shows slight differences in the bust of the average triangular, hourglass and rectangular shapes. These differences were confirmed from the measurements, as the predominant African body shape pairs recorded very small and negligible differences which were not statistically significant. Yet visually, the average hourglass shape appeared to have the narrowest waist, followed by the triangular shape. The rectangular shape had the widest waist; however, these visual differences could not be confirmed by the measurements as there were no significant differences in the waist measurements between the African body shape pairs (**Table 5.5**). The hips of an average triangular shape were wider and rounder than those of the African hourglass and the African rectangular shapes. An average African hourglass shape had moderately round hips with medium fullness, whereas an average rectangle had slightly round hips with the least amount of fullness. However, the measurements could only confirm the visual differences between the African triangle and the African hourglass, where the African triangle had significantly larger hips and thighs than the African hourglass (**Table 5.5**). These differences are typical body shape characteristics of each of these body shapes, and they were also confirming literature records even though they were not significantly different from the measurements (Rasband, 1994:12-13; Rasband & Liechty, 2006:24-25).

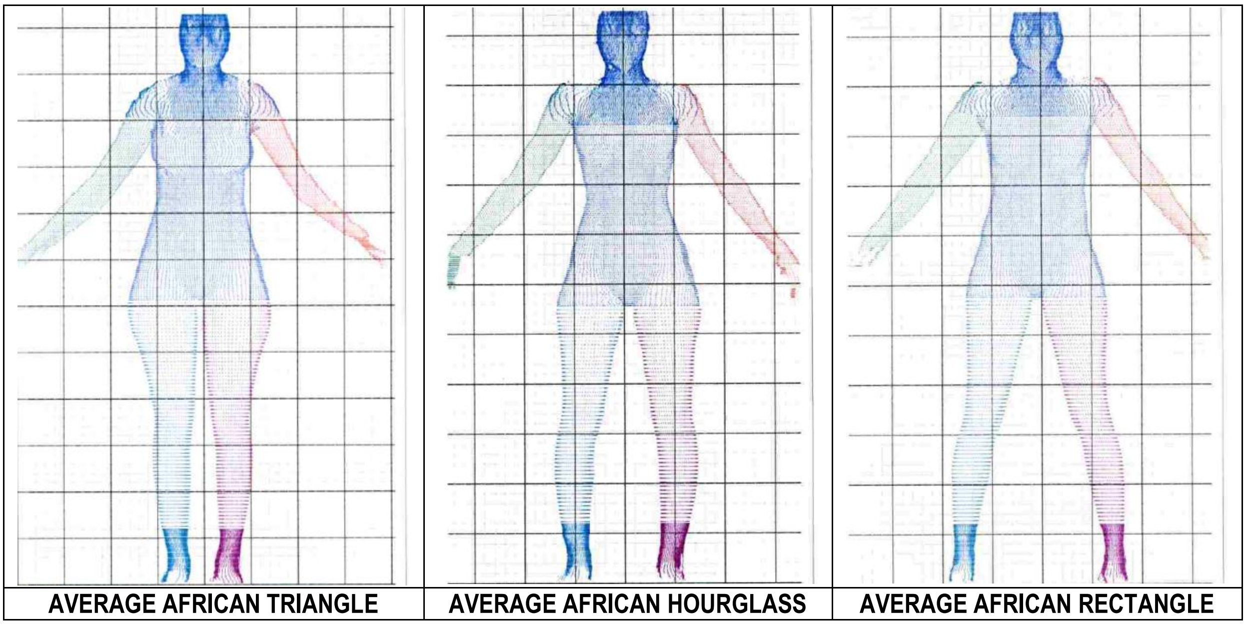


FIGURE 5.21: FRONT VIEW COMPARISON OF THE THREE PREDOMINANT AFRICAN BODY SHAPES

5.4.5 Visual comparison of images of the three predominant Caucasian body shapes

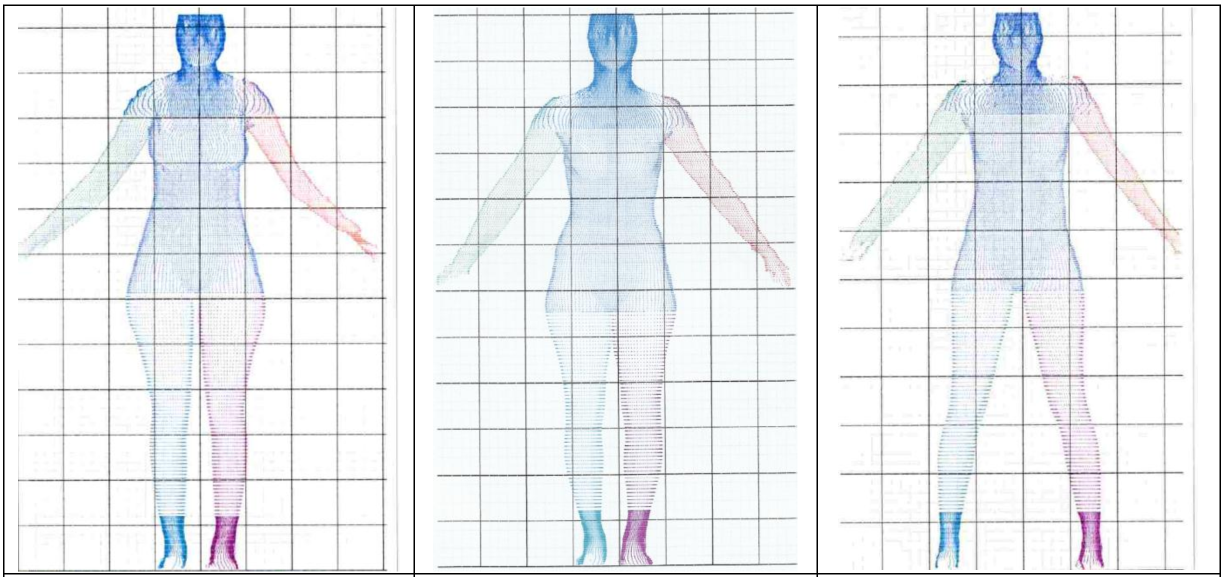
Figure 5.22 illustrates the front view of the average Caucasian triangle, hourglass and rectangle shapes. These front view images of the three Caucasian body shapes indicate that the average hourglass has the smallest/narrower stomach, waist and abdomen than both the triangle and rectangular shapes. On the other hand, the rectangular shape has the widest stomach, waist and abdomen, whereas the triangular shape has the widest, fully round hips. However, the measurements that recorded significant differences were the waist circumference and hip width, where the Caucasian triangle had a significantly smaller waist and significantly wider hips than the Caucasian rectangle, as shown in **Tables 5.4** and **5.5** respectively.

AVERAGE CAUCASIAN TRIANGLE	AVERAGE CAUCASIAN HOURGLASS	AVERAGE CAUCASIAN RECTANGLE

FIGURE 5.22: FRONT VIEW COMPARISON OF THE THREE PREDOMINANT CAUCASIAN BODY SHAPES

5.4.6 Visual comparison of front view images of the Caucasian hourglass and the African body shapes

This study then compared the different predominant African body shapes to the Caucasian (Western) hourglass in order to determine differences in body shape characteristics. Body shapes that differ from the Caucasian (Western) hourglass, i.e. the standard figure used in the apparel industry, are likely to experience RTW apparel fit problems. From the front view images in **Figure 5.23**, it is evident that the Caucasian hourglass has a narrower, more indented waist than both the African triangle and rectangle. The Caucasian hourglass has slightly rounder hips than the African rectangle; however, the hips and thighs were smaller than those of the African triangle. These differences were confirmed from literature (Rasband & Liechty, 2006:24-25), as well as from measurements, where the Caucasian hourglass recorded hip and thigh circumferences and a hip width that were smaller than the African triangle (**Table 5.5**).



AVERAGE AFRICAN TRIANGLE	AVERAGE CAUCASIAN HOURGLASS	AVERAGE AFRICAN RECTANGLE

FIGURE 5.23: FRONT VIEW COMPARISON OF CAUCASIAN HOURGLASS AND AFRICAN BODY SHAPES

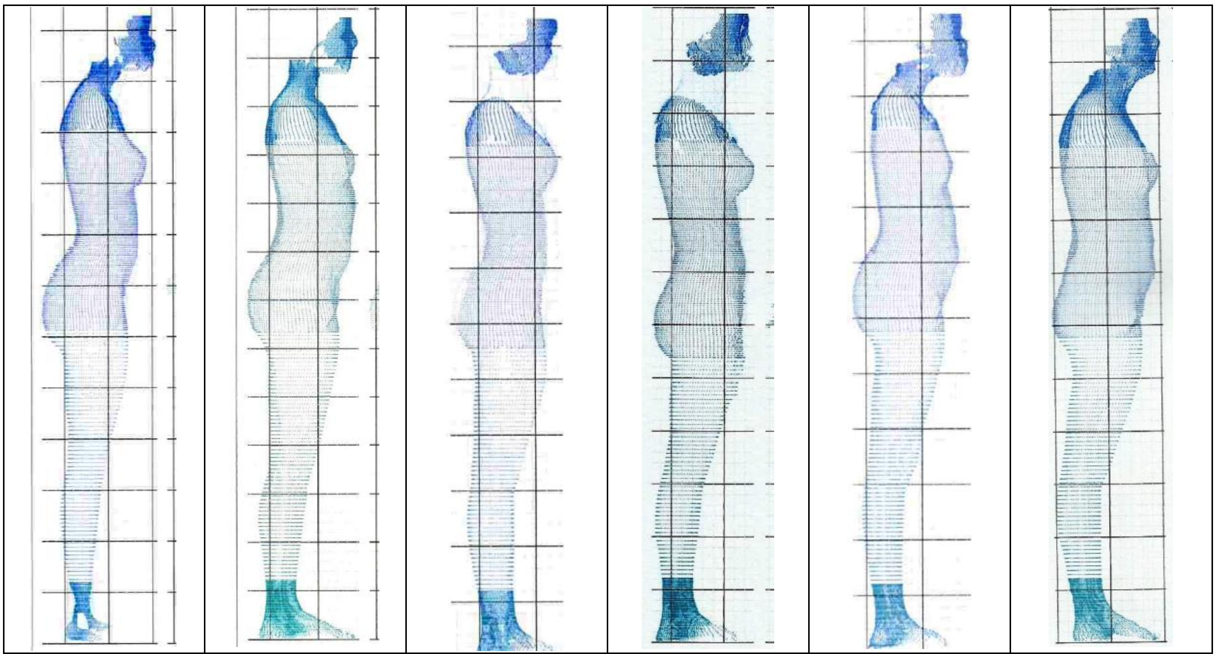
5.4.7 Visual comparison of body protrusions/side view of African and Caucasian body shapes

5.4.7.1 Visual comparison of body protrusions/side view of African and Caucasian triangular body shapes

The side view of 3-D body scan images of the average African and Caucasian body shapes were analysed to compare body protrusions.

A visual analysis of the side view of an average African triangular shape appeared to have a more prominent bust than an average Caucasian triangle, which has a smaller bust. However, it is clear that from the measurements that the bust circumferences as well as the bust protrusions of the African triangle and the Caucasian triangle were not significantly different.

From the 3-D scan images the stomach, waist and abdomen of an average African triangle appeared to be flat; yet an average Caucasian triangle had a slight fullness extending from the stomach to the abdomen, appearing like a moderate “D” shape. However, as reflected in **Table 5.4**, the stomach, waist and abdomen measurements between these African and Caucasian triangular shapes showed no significant difference. On the other hand, an average African triangular shape had a deeper hollowed lower back curvature. The deep lower back curvature made the buttocks appear larger and more fully round, extending like a "d" shape, whereas an average Caucasian triangular shape had a moderately hollow lower back as well as moderately rounded buttocks with a medium fullness. Furthermore, an average African triangular shape had thighs with a medium bulge, while an average Caucasian triangle had a smaller thigh bulge (**Figure 5.23**). This was the only visual difference that was confirmed by measurements through the thigh circumference in **Table 5.4**.



AFRICAN TRIANGLE	CAUCASIAN TRIANGLE	AFRICAN HOURGLASS	CAUCASIAN HOURGLASS	AFRICAN RECTANGLE	CAUCASIAN RECTANGLE

FIGURE 5.24: VISUAL COMPARISON OF BODY PROTRUSIONS OF AFRICAN AND CAUCASIAN BODY SHAPES

5.4.7.2 Visual comparison of body protrusions/side view of the African and Caucasian hourglass body shape

A visual analysis of an average Caucasian hourglass shape shows a more prominent bust than an average African hourglass, which has a smaller bust. In the literature (Rasband, 1994:13; Rasband & Liechty, 2006:25) it is stated that the hourglass shape has a medium to large bust, as also observed in this study. A side view analysis of the 3-D body scan images also revealed that the African hourglass shapes had flatter and less prominent stomachs and abdomens, with no waist indentation, whereas the Caucasian hourglass has a flat stomach with a little fullness below the waist, extending like a less prominent "b" shape. The measurements confirm the abdomen differences, as the Caucasian hourglass has a significantly wider and more prominent abdomen than the African hourglass, as shown in **Tables 5.4** and **Table 5.5** respectively. According to the literature, an hourglass shape has an indented waist, as the midriff (stomach and abdomen and upper hips) tapers towards the waist, which is more evident from a front view analysis. Both the average African and Caucasian hourglass have moderately hollow lower backs, an indication of a smaller waist line. It should be noted that, unlike the front view 3-D scan image, the side view images do not clearly show whether a waistline is indented or not. Both the average African and Caucasian hourglass shapes appeared to have moderately round buttock and thighs, with an average thigh bulge (**Figure 5.24**) all of which were not significantly different from the circumferential measurements as well as the body protrusions.

5.4.7.3 Visual comparison of body protrusions/side view of the African and Caucasian rectangular body shape

The literature records that the bust of the rectangular shape is small to medium (Rasband, 1994:12). The African rectangular shape had a very small and less prominent bust than the Caucasian rectangular shape, whose bust was small but slightly prominent. Both rectangular shapes had a moderately prominent stomach, waist and abdomen. The average African rectangular shape had a moderate stomach, waist and abdomen fullness, extending from the bust to the crotch in a moderate “D” shape. In contrast, the average Caucasian rectangular shape has a moderate stomach and abdomen fullness and a slight indentation at the waist, therefore giving a fullness that extends in a moderate “B” shape. These findings confirm the literature: according to Rasband (1994:12) and Rasband and Liechty (2006:25), a rectangular shape has a bust, waist and hips that are nearly the same size and a midriff (stomach and abdomen) that tapers very little towards the waist. Even though there were slight differences in the bust, stomach, waist, abdomen and seat circumferential and seat width measurements of African and Caucasian rectangular shaped women, none of these differences were significant except for the abdomen width (**Tables 5.4** and **5.5**). The Caucasian rectangular shapes had wider abdomens than the African rectangular shapes. The African rectangular shape had a moderately hollowed lower back as well as moderately rounded buttocks. In contrast, an average Caucasian rectangular shape had a shallow lower back curvature and buttocks with a very small fullness. Both the African and Caucasian rectangular shapes had a moderate thigh bulge (**Figure 5.24**), as also stated in the literature (Rasband, 1994:138). However, there were no significant differences in the circumferential measurements or body protrusions of the African and Caucasian rectangle (**Tables 5.4** and **5.6**).

5.4.7.4 Visual comparison of body protrusions/side view of predominant African body shapes

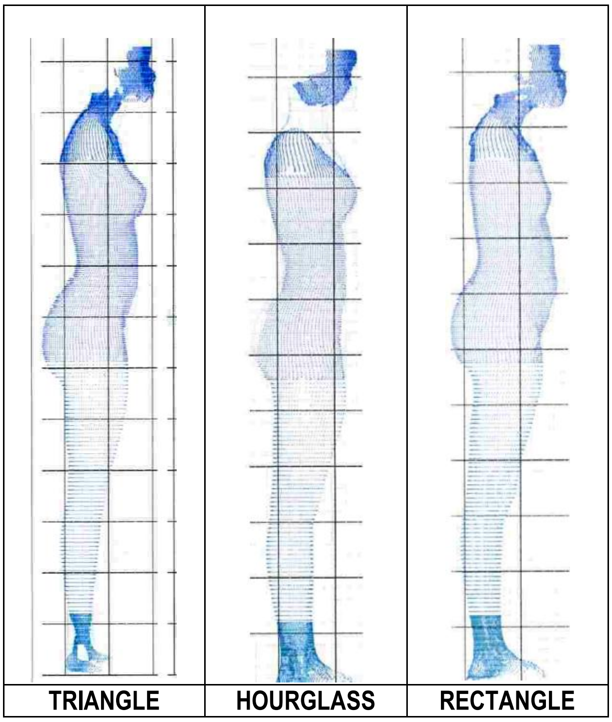


FIGURE 5.25: A SIDE VIEW COMPARISON OF THE THREE PREDOMINANT AFRICAN BODY SHAPES

This study further analysed and compared the 3-D side view images of the predominant African and Caucasian body shapes. This was to determine how the body protrusions of the predominant African body shape pairs compare. **Figure 5.25** illustrates the side view comparisons of the average African body shapes, which reveals that the hourglass shape has a larger bust prominence than the triangular shape. The triangular shape has a moderate bust prominence than the rectangular shape whose bust was the least prominent. The stomach, waist and abdomen of the hourglass shape are smaller and flatter, whereas the triangular shape has a moderate stomach, waist and abdomen prominence and the rectangular shape has the most prominent stomach, waist and abdomen. An average African triangular shape has a deeper hollowed lower back curvature that makes the buttocks appear larger and fully round.

Visually, the African triangular shape has larger buttocks and thigh bulge than both the African hourglass and the African rectangular shapes, which have moderate buttock protrusion and thigh bulge (**Figure 5.25**), as indicated in Rasband (1994:138) and Rasband and Liechty (2006:24-25). The Kruskal-Wallis test confirmed only the difference in thigh bulge, where the African triangular shape recorded a significantly larger thigh circumference than the African hourglass.

5.4.7.5 Visual comparison of body protrusions/side view of the predominant Caucasian body shapes

Figure 5.26 illustrates the differences in body protrusion between the average Caucasian triangle, hourglass and rectangle shape pairs. A side view comparison shows that the average Caucasian triangular shape has the smallest bust prominence, compared to the average Caucasian rectangular shape, which has a moderate bust prominence, even though from the measurements only the Caucasian hourglass and the Caucasian triangle recorded significant differences in bust circumference and bust protrusion (**Tables 5.4** and **5.6**). These differences were confirmed from the literature, as the Caucasian hourglass had the highest bust circumference, followed by the Caucasian rectangle then the Caucasian triangle. The hourglass shape has the smallest and flattest stomach, waist and abdomen, followed by the triangular shape that has moderate prominence on the same. The rectangular shape has a slightly more prominent stomach, waist and abdomen than both the Caucasian triangle and the Caucasian hourglass. Rasband (1994:12-13) confirms that on average triangular shapes have smaller upper bodies and wider lower bodies than the hourglass, which is characterised by rounder bust and hips and a more defined waistline than rectangular shapes, whose bust, waist and hips are nearly equal. Average Caucasian triangular and hourglass shapes have a moderately hollow lower back as well as moderately rounded buttocks with a medium fullness. An average Caucasian hourglass has a moderately round upper back and moderately hollow lower back, like the average triangular shape, but the latter has a fully round upper back. Both the average rectangular and the average hourglass shapes have a moderate thigh bulge, which is in line with the literature (Rasband, 1994:138). The buttocks of the triangle and hourglass shapes were moderately rounder than the rectangular shape, which showed the smallest buttock fullness. All of these differences were unlike those recorded in the literature, except for the lower waist differences and the lower bodies, where the literature states that rectangle shapes have wider waist circumferences than triangle shapes, and also that triangular and hourglass shapes have rounder and wider lower bodies respectively (Rasband, 1994:12-13).

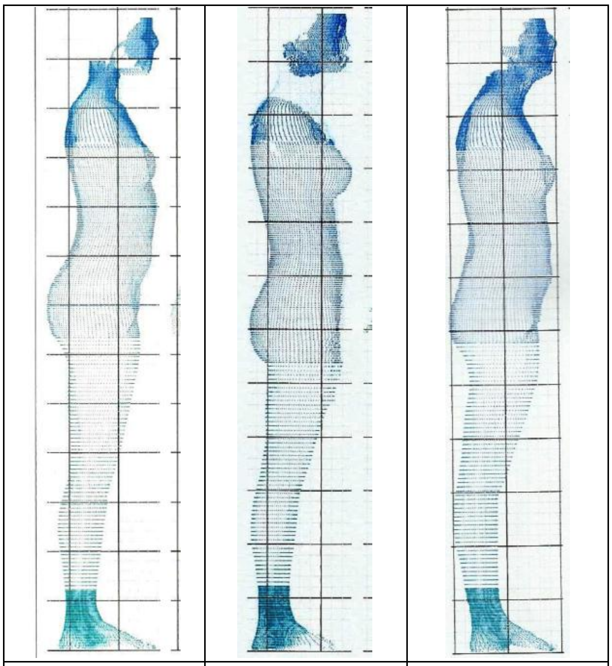


FIGURE 5.26: A SIDE VIEW COMPARISON OF THE THREE PREDOMINANT CAUCASIAN BODY SHAPES

5.4.7.6 Comparison of visual body /side view of the Caucasian hourglass and African body shapes

Figure 5.26 shows that the Caucasian hourglass has a larger bust and flatter stomach, waist and abdomen than both the African triangle and the African rectangle. Visually, the buttocks of the Caucasian hourglass appeared to be slightly more round but smaller than the African triangle. This was due to the deep lower back curvature which made the buttocks appear to be larger than what they actually were. These differences were consistent with what is recorded in the literature (Rasband & Liechty, 2006:24-25). On the other hand, the measurements indicate that the Caucasian hourglass had a significantly larger bust circumference and protrusion and significantly smaller hip, seat and thigh circumferences than the African triangle (**Table 5.4**). More specifically, the Caucasian hourglass had a bust circumference and protrusion of 4.6 cm and 2.7 cm respectively larger, as well as hip, seat and thigh circumferences of 6.2 cm, 4.8 cm and 4.3 cm respectively smaller than the African triangle.

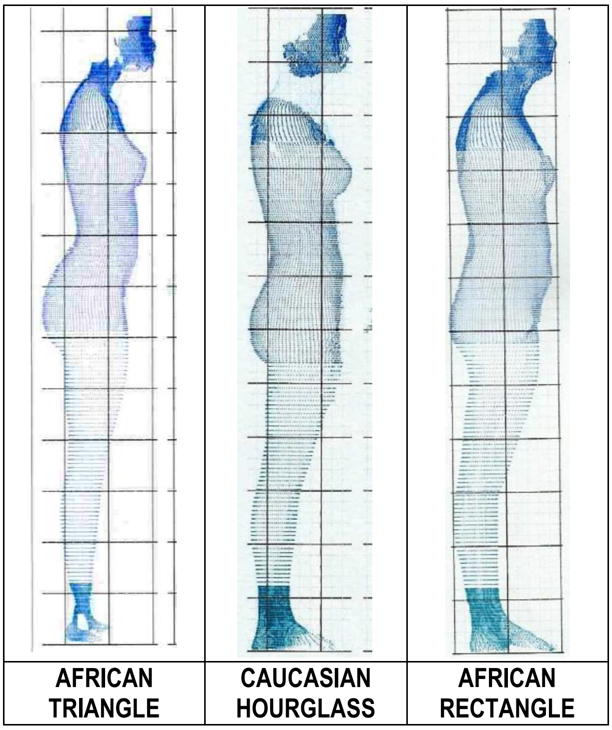


FIGURE 5.27: A SIDE VIEW COMPARISON OF THE CAUCASIAN HOURGLASS AND AFRICAN BODY SHAPES

5.5 SUMMARY OF THE COMPARISON OF BODY MEASUREMENTS AND MEASUREMENT RATIOS OF THE CAUCASIAN HOURGLASS AND THE PREDOMINANT BODY SHAPES

It is important to understand how each figure shape differs from the ideal figure, and also to identify where the differences exist (Rasband, 1994:51; Rasband & Liechty, 2006:24). When one's body shape differs from the ideal figure, RTW apparel fit problems are likely to result. This study focuses on how each of the predominant African and Caucasian body shapes differs from the Caucasian hourglass, which in this study is assumed to be similar to the Western hourglass. It is also believed that this is the body shape used by the apparel industry as a design base. Furthermore, this study investigates how critical fit points of predominant African and Caucasian body shapes differ. Critical fit points identified in this study are: bust, stomach, waist, abdomen, hips, buttocks and thighs, as well as height dimensions.

As is clear from **Table 5.10**, most body measurement differences that could seriously impact on fit occur between the Caucasian hourglass and the Caucasian triangle, the Caucasian hourglass and the African hourglass, as well as the Caucasian hourglass and the African triangle. As noted in the literature (Rasband, 1994:88; Rasband & Liechty, 2006:202), the Caucasian triangle has a significantly smaller bust circumference and bust protrusion, and therefore also has a significantly smaller bust to waist ratio. Furthermore, due to their larger hips, they also have bigger hip to waist and smaller bust to hip ratios. One could therefore predict loose fitting in a dress's bodice or tight fitting apparel around the hips and thighs.

As could be expected from previous research (Rasband, 1994: 12, 94; Rasband & Liechty, 2006:25), when compared to the Caucasian hourglass, the Caucasian rectangle shape has a significantly larger waist and therefore also a significantly smaller bust to waist and hip to waist ratio. That could result in a too tight fit around the waist.

A comparison between the African hourglass and the Caucasian hourglass clearly demonstrates the ethnic differences between the same body shapes. The African hourglass is shorter than the Caucasian hourglass, with shorter bust and waist heights. These may impact in the way that skirt, dress and trouser lengths fit the young African hourglass consumer. The African hourglass also has a significantly smaller abdomen circumference, width and protrusion, which may result in loose fitting skirts and trousers just below the waist.

The most significant differences exist between the Caucasian hourglass and the African triangle, which counts for the largest body shape group (58.7%) of the total African sample. When compared to the Caucasian hourglass, the African triangle has a significantly smaller bust circumference, smaller bust protrusion, smaller abdomen width, smaller bust to waist ratio, and significantly shorter total body and bust heights. This shape has on the other hand a significantly larger hip, seat and thigh circumference, significantly larger hip to waist and smaller bust to hip ratios. One can therefore predict major fit problems for the African triangular body shape, with either loose fitting in the bodice or tight fitting in the lower body. As is the case with the Caucasian rectangular shape, the African rectangular shape has only a small number of minor differences when compared to the Caucasian hourglass.

TABLE 5.10: SUMMARY OF BODY MEASUREMENTS AND MEASUREMENT RATIOS OF THE AFRICAN AND CAUCASIAN BODY SHAPES

Analysis of body measurements	Caucasian hourglass	Caucasian triangle	Caucasian rectangle	African hourglass	African triangle	African rectangle
Circumferences	Assumed to be nearest to industry's ideal figure	Smallest bust	-	Smallest abdomen circumference	Smallest bust circumference, larger hip, seat and thigh circumferences	–
Widths	–	Larger hip width	Larger waist width	Smaller abdomen width	Smaller abdomen width Larger hip width	–
Protrusions	–	Smaller bust protrusion	–	Smaller abdomen protrusion	Smaller bust protrusion	–
Height	–	–	–	Shorter total body, bust and waist height	Shorter total body and bust height	Shorter total body and bust height
Circumferential ratios	–	Smaller bust to waist ratio Larger hip to waist ratio Smaller bust to hip ratio	Smaller bust to waist ratio Smaller hip to waist ratio	–	Smaller bust to waist ratio Larger hip to waist ratio Smaller bust to hip ratio	Smaller bust to waist ratio
Height ratios	–	–	Larger total body to waist height ratio	–	Smaller total body to waist ratio	–
Predicted fit problems	–	Loose fitting in bodice and tight fitting in lower body	Tight fitting apparel at waist	Loose fitting apparel around the abdomen	Loose fitting apparel in bodice, tight fitting in lower body and loose fitting apparel around the waist	Tight fitting apparel around the waist

5.6 PERCEIVED RTW APPAREL FIT PROBLEMS AND FIT IMPLICATIONS ASSOCIATED WITH AFRICAN AND CAUCASIAN BODY SHAPES (OBJECTIVE 3)

Participants were required to indicate on a nominal scale in the questionnaire (**Section C: Question 6)** whether they experienced 1 – *too tight*, 2 – *too loose* or 3 – *no apparel fit problems* at each of the selected body parts.it should be noted that the RTW apparel fit problems reported by participants in this study are not specific to any particular apparel category but were general. In order for retailers to satisfy the female apparel market's fit needs, one could expect them to cater for at least 60% of the target market. **Table 5.11** shows the perceived fit problems of the predominant African and Caucasian body shapes. The discussion focuses on cases where more than 40% of the body shapes perceived fit problems at each of the selected body parts.

TABLE 5.11: FREQUENCY TABLE OF FIT PROBLEMS EXPERIENCED BY AFRICAN AND CAUCASIAN BODY SHAPES

Body part	Fit problem		African triangle f = 64	Caucasian triangle f = 42	African hourglass f = 30	Caucasian hourglass f = 51	African rectangle f = 14	Caucasian rectangle f = 32	Total Count (%) n = 233
Bust	Tight	Frequency	14	13	10	19	2	15	73 (31)
		Expected	20.05	13.16	9.40	15.98	4.37	10.03	
		Column %	21.9	31.0	33.3	37.3	14.3	46.9	
	Loose	Frequency	19	24	10	15	5	10	83 (36)
		Expected	22.80	14.96	10.69	18.17	4.99	11.40	
		Column %	29.7	57.1	33.3	29.4	35.7	31.3	
	No fit problem	Frequency	31	5	10	17	**7**	7	77 (33)
		Expected	21.15	13.88	9.91	16.85	4.63	10.58	
		Column %	48.4	11.9	33.3	33.3	50.0	21.9	
Stomach	Tight	Frequency	19	13	8	26	7	15	88 (38)
		Expected	24.17	15.86	11.33	19.26	5.29	12.09	
		Column %	29.7	31.0	26.7	51.0	50.0	46.9	
	Loose	Frequency	19	6	8	3	3	6	45 (19)
		Expected	12.36	8.11	5.79	9.85	2.70	6.18	
		Column %	29.7	14.3	26.7	5.9	21.4	18.8	
	No fit problem	Frequency	26	23	14	22	4	11	100 (43)
		Expected	27.47	18.02	12.88	21.89	6.01	13.73	
		Column %	40.6	54.8	46.7	43.1	28.6	34.4	
Waist	Tight	Frequency	14	12	7	21	4	8	66 (28.3)
		Expected	18.13	11.80	8.50	14.45	3.97	9.06	
		Column %	21.9	28.6	23.3	41.2	28.6	25	
	Loose	Frequency	35	10	12	10	3	13	83 (35.6)
		Expected	22.80	14.96	10.69	18.17	4.99	11.40	
		Column %	54.7	23.8	40.0	19.6	21.4	40.6	
	No fit problem	Frequency	15	20	11	20	7	11	84 (36.1)
		Expected	23.07	15.14	10.82	18.39	5.05	11.54	
		Column %	23.4	47.6	36.7	39.2	50.0	34.4	

TABLE 5.11: FREQUENCY TABLE OF FIT PROBLEMS EXPERIENCED BY AFRICAN AND CAUCASIAN BODY SHAPES CONTINUED

Body part	Fit problem		African triangle f = 64	Caucasian triangle f = 42	African hourglass f = 30	Caucasian hourglass f = 51	African rectangle f = 14	Caucasian rectangle f = 32	Total Count (%) n = 233
Abdomen	Tight	Frequency	20	13	7	28	6	16	90 (39)
		Expected	24.72	16.22	11.59	19.70	5.41	12.36	
		Column %	31.5	31.0	23.3	54.9	42.9	50.0	
	Loose	Frequency	18	5	6	4	3	3	39 (17)
		Expected	10.71	7.03	5.02	8.54	2.34	5.36	
		Column %	28.1	11.9	20.0	7.8	21.4	9.4	
	No fit problem	Frequency	26	24	17	19	5	13	104 (44)
		Expected	28.57	18.74	13.39	22.76	6.25	14.28	
		Column %	40.6	57.1	56.7	37.3	35.7	40.6	
Hips	Tight	Frequency	43	33	12	33	3	15	139 (60)
		Expected	38.18	25.06	17.80	30.43	8.35	19.09	
		Column %	67.2	78.6	40.0	64.7	21.4	46.9	
	Loose	Frequency	9	4	12	5	3	4	37 (16)
		Expected	10.16	6.67	4.76	8.10	2.22	5.08	
		Column %	14.1	9.5	40.0	9.8	21.4	12.5	
	No fit problem	Frequency	12	5	6	13	8	13	57 (24)
		Expected	15.66	10.28	7.34	12.48	3.42	7.83	
		Column %	18.8	11.9	20.0	25.6	57.1	40.6	
Seat/ Buttocks	Tight	Frequency	37	27	5	18	5	13	105 (45)
		Expected	28.84	18.93	13.52	22.98	6.31	14.42	
		Column %	57.8	64.3	16.7	35.3	35.7	40.6	
	Loose	Frequency	8	6	12	14	5	5	50 (21)
		Expected	13.73	9.01	6.44	10.94	3.00	6.87	
		Column %	12.5	14.3	40.0	27.5	35.7	15.6	
	No fit problem	Frequency	19	9	13	19	4	14	78 (34)
		Expected	21.43	14.06	10.04	17.07	4.69	10.71	
		Column %	29.7	21.4	43.3	37.3	28.6	43.7	

TABLE 5.11: FREQUENCY TABLE OF FIT PROBLEMS EXPERIENCED BY AFRICAN AND CAUCASIAN BODY SHAPES CONTINUED

Body part	Fit problem		African triangle f = 64	Caucasian triangle f = 42	African hourglass f = 30	Caucasian hourglass f = 51	African rectangle f = 14	Caucasian rectangle f = 32	Total Count (%) n = 233
Thighs	Tight	Frequency	41	34	12	34	2	19	142 (61)
		Expected	39.00	25.60	18.28	31.08	8.53	19.50	
		Column %	64.1	81.0	40.0	66.7	14.3	59.4	
	Loose	Frequency	5	0	9	9	4	3	30 (13)
		Expected	8.24	5.41	3.86	6.57	1.80	4.12	
		Column %	7.8	0	30	17.7	28.6	9.4	
	No fit problem	Frequency	18	8	9	8	8	10	142 (61)
		Expected	16.76	11.00	7.85	13.52	3.67	8.38	
		Column %	28.1	19.1	30.0	15.7	57.1	31.3	

Highest % highlighted in yellow

It is clear from **Table 5.11** that in the case of the Caucasian hourglass, that was expected to experience the least fit problems since it is believed to be similar to the Western hourglass that is used by the apparel industry as a design base, 51.0% expressed apparel tightness around the stomach, 41.2% experienced apparel tightness at the area around the waist, while 54.9% experienced too tight fit around the abdomen. An alarming 64.7% experienced too tight fit around the hips, while 66.7% also experienced too tight fit around the thighs. It therefore seems that a too tight fit in the mid-section and lower body is the most serious problem for the Caucasian hourglass.

Contrary to what was previously predicted from the measurements, the African hourglass had a significantly smaller abdomen area (than the Caucasian hourglass), yet did not report the predicted loose fit nor tight fit problems at the abdomen respectively, nor did they experience fit problems at the other selected body parts (**Table 5.11)**. Pisut and Connell (2007) observed that the hourglass shape experienced apparel fit problems at the bust, waist as well as at the lower body (hips and thighs) (Li *et al*., 2003). If one takes into consideration that both the African and the Caucasian hourglass in fact experienced apparel fit problems (loose and tight) in the lower body, it seems at this point that the South African apparel industry's hourglass shape may not be able to cater for both the African and the Caucasian hourglass shapes. One should, however, keep in mind that other factors such as body cathexis, personal fit preference, fashion trends, cultural and ethnic differences/influences, age, lifestyle (Brown, 1992:261) also impact on perceived fit problems (LaBat & DeLong, 1990; Robinson, 2003; Chattaraman & Rudd, 2006; Plutt, 2011; Shin, 2013).

It was predicted from the measurements that the Caucasian triangle with its significantly smaller, less prominent bust and larger hips than the Caucasian hourglass would experience loose apparel fit in the bodice or tight apparel fit in the lower body. **Table 5.11** shows that, as was predicted, the Caucasian triangle indeed experienced loose apparel fit (57.1%) at the bust and tight fit problems in the lower body. Specifically, 78.6% of the Caucasian triangle experienced a too tight fit around the hips, while 64.3% experienced a too tight fit around the buttocks and 81.0% reported a too tight fit around the thighs. These findings also confirmed what was recorded in the literature (Li *et al*., 2003; Alexander *et al*., 2005; Pisut & Connell, 2007). Many significant differences in body measurements were found between the African triangle and the Caucasian hourglass. It was therefore expected from the measurements that the African triangle might experience loose apparel fit in the bodice and/or tight fit in the lower body and/or loose fit at the waist. As was predicted, 54.7% of the African triangle experienced loose fit problems in the waist area, while 67.2% experienced too tight fit around the hips, 57.8% experienced too tight fit around the buttocks, and 64.1% experienced a too tight fit around the thighs. This confirms the literature (Li *et al*., 2003; Alexander *et al*., 2005; Pisut & Connell, 2007).

It was expected that, since the African rectangle shape that only showed minor measurement differences when compared to the Caucasian hourglass, it would experience the least fit problems. It is interesting to note that the current study identified the African rectangle as a body shape that experienced the least fit problems, while in a study by Li *et al*. (2003) the triangle shape experienced the least fit problems. **Table 5.11** confirmed the predictions, with only 50.0% African rectangular shapes who experienced fit problems of tightness around the stomach, and only 42.9% who perceived tightness around the abdomen. Li *et al*. (2003) also reported that fit problems are common at the midsection of rectangular shaped women. From these findings it seems that the South African industry's ideal figure may cater better for the African rectangle than for all the other African and Caucasian body shapes.

Table 5.11 shows that the same number (46.9%) of Caucasian rectangle experienced tightness around the bust as well as the stomach. Fifty percent (50.0%) experienced a tight fit around the abdomen, 46.9% reported a tight fit around the hips, and 59.4% a tight fit around the thighs. These findings contradict what was expected from the measurements, as the Caucasian rectangle and Caucasian hourglass recorded no significant differences in all the circumferential, protrusions and height measurements except with waist width. Since the Caucasian rectangle had a significantly wider waist than the Caucasian hourglass, it was therefore unexpected that they would report no fit problems. Alexander *et al*. (2005) and Pisut and Connell (2007) show that the rectangular shape does not only have a wider waist, but has an almost equal body from shoulders to hips, that it is larger than average (Rasband & Liechty, 2006:25). The rectangular shape was therefore not only expected to experience a tight fit at the waist but at almost all the other selected body parts. Furthermore, Li *et al*. (2003) confirmed that rectangular shaped women experienced problems of tight fit at the waist, abdomen, hips, buttocks and thighs. This is consistent with the literature, yet it contradicted what was found by this study with the Caucasian rectangle. The literature also records that women of the same body shape but different ethnicity have different body shape characteristics and therefore experience different fit problems (Shin & Istook, 2007).

5.7 SELECTED BODY PARTS' CATHEXIS OF AFRICAN AND CAUCASIAN BODY SHAPES (OBJECTIVE 4)

Section B (Question 4) of the questionnaire was a modified body cathexis scale. It was administered to the 234 (109 African and 125 Caucasian) participants to investigate their cathexis level at the 7 selected body parts. These were**:** bust, stomach, waist, abdomen, hips, buttocks and thighs.

The participants were required to indicate on a 7-point Likert scale whether they were 1 – *extremely dissatisfied, 2 – dissatisfied, 3 – slightly dissatisfied*, 4 – *neither, 5 – slightly satisfied, 6 – satisfied,* and 7 – *extremely satisfied* with each of the selected body parts. Their responses were summarised according to the six predominant African and Caucasian body shapes. The 234 participants were distributed between the 7 cathexis categories, six body shapes and seven selected body parts. However, the data was too sparse (cell count of < 5 at expected frequency) at more than 25% of the cells for a statistical test (Chi-square) to be conducted. Therefore, the Likert scale was condensed as follows: 1 – *extremely dissatisfied, 2 – dissatisfied,* and *3 – slightly dissatisfied* were merged into the *dissatisfied* category, 4 – *neither remained unmerged,* and *5 – slightly satisfied, 6 – satisfied* and 7 – *extremely satisfied* were merged into the *satisfied* category. This resulted in three cathexis categories, namely: satisfied, neither and dissatisfied. The findings on the participants' cathexis levels with the selected body parts are presented in **Table 5.12.**

TABLE 5.12: BODY PARTS CATHEXIS OF AFRICAN AND CAUCASIAN BODY SHAPES

Body part	Body Cathexis	African triangle f = 64	Caucasian triangle f = 42	African hourglass f = 30	Caucasian hourglass f = 51	African rectangle f = 14	Caucasian rectangle f = 32	Total Count (%) n = 233
Bust	Dissatisfied	10 (15.6)	8 (19.1)	4 (13.3)	6 (11.8)	2 (14.3)	7 (21.9)	37
	Neither	6 (9.4)	3 (7.1)	4 (13.3)	5 (9.8)	1 (7.1)	3 (9.4)	22
	Satisfied	48 (75.0)	31 (73.8)	22 (73.3)	40 (78.4)	11 (78.6)	22 (68.8)	174
	Total	64	42	30	51	14	32	233
Stomach	Dissatisfied	29 (45.3)	15 (35.7)	9 (30.0)	24 (47.1)	8 (57.1)	16 (50.0)	101
	Neither	3 (4.7)	2 (4.8)	4 (13.3)	3 (5.9)	0 (0)	2 (6.3)	14
	Satisfied	32 (50.0)	25 (59.5)	17 (56.7)	24 (47.1)	6 (42.9)	14 (43.8)	118
	Total	64	42	30	51	14	32	233
Waist	Dissatisfied	13 (20.3)	13 (31.0)	5 (16.7)	12 (23.5)	6 (42.9)	11 (34.4)	60
	Neither	4 (6.3)	0 (0)	2 (6.7)	6 (11.8)	0 (0)	3 (9.38)	15
	Satisfied	47 (73.4)	29 (69.1)	23 (76.7)	33 (64.7)	8 (57.1)	18 (56.3)	158
	Total	64	42	30	51	14	32	233
Abdomen	Dissatisfied	24 (37.5)	16 (38.1)	7 (23.3)	24 (47.1)	5 (35.7)	18 (56.3)	94
	Neither	7 (10.9)	3 (7.1)	1 (3.3)	6 (11.8)	1 (7.14)	3 (9.4)	21
	Satisfied	33 (51.7)	23 (54.8)	22 (73.3)	21 (41.2)	8 (57.1)	11 (34.4)	118
	Total	64	42	30	51	14	32	233
Hip	Dissatisfied	13 (20.3)	19 (45.2)	3 (10.0)	23 (45.1)	6 (42.3)	13 (40.6)	77
	Neither	2 (3.13)	3 (7.14)	2 (6.7)	3 (5.9)	0 (0)	3 (9.4)	13
	Satisfied	49 (76.6)	20 (47.6)	25 (83.3)	25 (49.0)	8 (57.1)	16 (50)	143
	Total	64	42	30	51	14	32	233
Seat	Dissatisfied	16 (25.0)	21 (50.0)	3 (10.0)	17 (33.3)	8 (57.1)	13 (40.6)	78
	Neither	3 (4.7)	4 (9.42)	3 (10.0)	6 (11.7)	0 (0.0)	5 (15.6)	21
	Satisfied	45 (70.3)	17 (40.5)	24 (80)	28 (54.9)	6 (42.9)	14 (43.8)	134
	Total	64	42	30	51	14	32	233
Thighs	Dissatisfied	26 (40.6)	30 (71.4)	4 (13.3)	28 (54.9)	4 (28.6)	21 (65.6)	113
	Neither	6 (9.4)	0 (0.0)	4 (13.3)	10 (19.6)	0 (0.0)	3 (9.4)	23
	Satisfied	32 (50.0)	12 (28.6)	22 (73.3)	13 (25.5)	10 (71.4)	8 (25)	97
	Total	64	42	30	51	14	32	233

Majority of participants satisfied with body part are highest in yellow, dissatisfied highlighted in red.

Again, concentrating on more than 40% of the participants' cathexis level per body shape category as highlighted in yellow (**Table 5.12**) in each of the selected body parts, it is clear from **Table 5.12** that the Caucasian hourglass body shape (which resembles the shape that is generally viewed as ideal) group were mostly satisfied with their body parts, namely with their bust (78.4%), waist (64.7%), hips (49.0%) and seat (54.9%). However, the same percentage of Caucasian hourglass (47.1%) who were dissatisfied with both their stomach and abdomen, were also satisfied with their stomach. A majority of the Caucasian hourglass shape were dissatisfied with their stomach (47.1%) and abdomen (47.1%) hips (45.1%) and thighs (54.9%), and a majority of these also reported tight apparel fit problems at these body parts. These findings confirm previous literature (LaBat & DeLong, 1990; Feather *et al*., 1996; Robinson, 2003; Chattaraman & Rudd, 2006) which noted that participants cited apparel fit problems on body parts where they were dissatisfied.

It is interesting to note that even though the African hourglass reported problems with fit at some of the body parts, they were still satisfied (in most cases above 70%) with all the selected body parts. The differences in fit problems and body part cathexis reported by African and Caucasian hourglass confirm the findings by Manuel *et al*. (2010) that ethnicity may influence participants' body shape characteristics, fit problems as well as body parts' cathexis.

The Caucasian triangle whose body shape differs markedly from that of the Caucasian hourglass figure, reported dissatisfaction only with the hips (45.2%), seat (50.1%) and thighs (71.4%). These are also the body parts that notably differ in shape and size from the Caucasian hourglass figure. It was at the same body parts where Caucasian triangular participants expressed dissatisfaction that they also cited apparel tightness. These findings suggest a relationship between fit problems and low body part cathexis, as well as absence of fit problems and high body part cathexis (LaBat & DeLong, 1990; Feather *et al*., 1996; Robinson, 2003; Chattaraman & Rudd, 2006; Chattaraman, Simmons & Ulrich, 2013).

On the other hand, the African triangle group, whose shape mostly differs from the Caucasian hourglass, seem to be mostly satisfied with their body parts. There were only 45.3% who expressed dissatisfaction with the stomach, yet another 50.0% were satisfied with both their stomach and thighs. Although they reported apparel fit problems of tightness at the hips, buttocks and thigh areas, they were satisfied with these body parts, which is contrary to what is recorded in the literature (LaBat & DeLong, 1990; Feather *et al*., 1996; Robinson, 2003; Chattaraman & Rudd, 2006).

The Caucasian rectangle, who only had a significantly larger waist than the Caucasian hourglass, also reported apparel fit problems of looseness, reported tight fit problems in almost all body parts and were also dissatisfied with all other selected body parts except the bust and waist. Specifically, they were dissatisfied with their stomach (50.0%), although another 43.8% were satisfied with their stomach. Furthermore, most of the Caucasian rectangular shaped participants were dissatisfied with the abdomen (56.3%) and the thighs (65.6%).

With regard to the African rectangle whose shape differs only slightly from the Caucasian hourglass shape, 57.1% were dissatisfied with the stomach as well as seat, yet another 42.9% were satisfied with both. They also reported tight fit around the stomach and not at the buttocks. The African rectangular shaped participants were also satisfied with their bust (78.6%) and abdomen (57.1%), yet also reported apparel tightness at the abdomen, which was unexpected, especially since they recorded no significant differences in these body measurements from those of the Caucasian hourglass. It is interesting to note that this shape (71.4%) together with the African hourglass (73.3%) and the African triangle (50.0%) were the only shapes who were satisfied with their thighs.

It should also be noted again that the three African body shapes (triangle, hourglass and rectangle) were the most satisfied with most of the selected body parts, compared to their Caucasian counterparts who were dissatisfied with most of the selected body parts. These findings confirmed what is suggested by Fitzgibbon *et al*. (2000), namely that ethnicity impacts on participants' level of satisfaction with body parts as was observed between African and Caucasian body shapes. This may be because African females do not identify or relate to a body shape and size regarded as ideal by Caucasian females, and therefore also do not compare their body shapes to the ideal Western body shape. Women compare themselves to a culturally ideal body, and an ideal African body shape is curvaceous and not as slim as the Caucasian (Western) ideal (Apeagyei *et al*., 2006; Boyington *et al*., 2007).

5.8 PARTICIPANTS' PERCEPTION OF AN IDEAL FIGURE AND ASSOCIATION WITH AFRICAN AND CAUCASIAN BODY SHAPES (OBJECTIVE 5)

This study also investigated participants' perception of an ideal figure. Participants were required to select a body shape they perceived to be ideal from body shape images in the questionnaire. According to the literature (Keiser & Garner, 2003; Frings, 2005:34, 39; Boorady, 2011), the Generation Y consumers' apparel purchasing behaviour is influenced by their interest in modern technology (internet, computer and television). They are reached through advertising in television shows, movies, websites and magazines. Therefore, the Generation Y is a consumer segment that is aware of the fashion figure that is used by the apparel industry as a design base. This was evident when the 234 participants were asked to select a figure shape they regarded as ideal, and a majority (> 50%) of all six body shapes selected the hourglass (**Figure 5.27**). Specifically, 56.3% African triangle, 80.5% Caucasian triangle, 53.3% African hourglass, 70.6% Caucasian hourglass, 64.3% African rectangle and 62.5% Caucasian rectangle selected the hourglass shape as an ideal body shape. If apparel consumers are knowledgeable on the ideal figure, they may select apparel styles that will give them an illusion of an ideal figure.

TABLE 5.13: BIVARIATE ANALYSIS OF PREDOMINANT BODY SHAPES' PERCEPTION OF AN IDEAL FIGURE

Body shape	A Triangle f (Col. %)	C Triangle f (Col. %)	A Hourglass f (Col. %)	C Hourglass f (Col. %)	A Rectangle f (Col. %)	C Rectangle f (Col. %)	Total f (%)
Triangle	23 (35.9)	4 (9.5)	11 (36.7)	4 (7.8)	2 (14.3)	1 (3.1)	45 (19.3)
Inverted Triangle	5 (7.8)	3 (7.1)	3 (10)	7 (13.7)	2 (14.3)	8 (25)	28 (12.0)
Hourglass	36 (56.3)	34 (80.5)	16 (53.3)	36 (70.6)	9 (64.3)	20 (62.5)	151 (64.8)
Rectangle	0 (0)	1 (2.4)	0 (0)	4 (7.8)	1 (7.1)	3 (9.4)	9 (3.9)
Total	64	42	30	51	14	32	233 (100)

Highest numbers highlighted in yellow. A: African & C: Caucasian

5.9 READY-TO-WEAR APPAREL FIT PREFERENCES AND ASSOCIATION WITH AFRICAN AND CAUCASIAN BODY SHAPES (OBJECTIVE 6)

This study also investigated participants' RTW apparel fit preferences of predominant African and Caucasian body shapes at each of the selected body parts. Participants were required to indicate on a nominal scale on **Section C**: **Question 7** of the questionnaire whether they preferred *1 – very closely fitted, 2 – fitted, 3 – semi-fitted, 4 – loosely fitted or 5 – very loosely fitted* apparel. However, due to the sparseness data as explained earlier, the 5-point nominal scale was condensed to three points, where *very closely fitted and fitted* were merged into *close fitted, semi-fitted* remained unchanged, *loosely fitted* and *very loosely fitted* were merged into *loose fit.* The findings of participants' apparel fit preference are summarised and presented in **Table 5.14**, and again discussion will concentrate on cases where over 40% participants reported a certain fit preference category at each of the selected body parts, which are highlighted in yellow (**Table 5.14)**.

TABLE 5.14: FREQUENCY TABLE OF FIT PREFERENCES OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES

Body part	Fit preference		African triangle f = 64	Caucasian triangle f = 42	African hourglass f = 30	Caucasian hourglass f = 51	African rectangle f = 14	Caucasian rectangle f = 32	Total count (%) n = 233
Bust	Close fit	Frequency	49	28	20	36	12	19	164 (70.4)
		Expected	45.0	29.7	21.1	35.9	9.9	29.7	
		Column %	76.6	66.7	66.7	70.6	85.7	59.4	
	Semi-fitted	Frequency	12	13	8	12	2	13	60 (25.8)
		Expected	16.5	10.8	7.7	13.1	3.6	8.2	
		Column %	18.8	30.9	26.7	25.5	14.3	40.6	
	Loose fit	Frequency	3	1	2	3	0	0	9 (3.9)
		Expected	2.5	1.6	1.2	12.0	0.5	1.2	
		Column %	4.7	2.4	6.7	5.9	0.0	0.0	
Stomach	Close fit	Frequency	34	18	17	17	6	9	101 (43.3)
		Expected	27.7	18.2	13.0	22.1	6.1	13.9	
		Column %	53.1	42.9	56.7	33.3	42.9	28.1	
	Semi-fitted	Frequency	15	16	11	18	4	14	78 (33.5)
		Expected	21.4	14.1	10.0	17.1	4.7	10.7	
		Column %	23.4	38.1	36.7	35.3	28.6	35.3	
	Loose fit	Frequency	15	8	2	16	4	9	54 (23.2)
		Expected	14.8	9.7	7.0	11.8	3.2	7.4	
		Column %	23.4	19.1	6.7	31.4	28.6	28.1	
Waist	Close fit	Frequency	45	23	27	28	9	16	148 (65.5)
		Expected	40.6	26.7	19.1	32.4	8.9	20.3	
		Column %	70.3	54.8	90.0	54.9	64.3	50.0	
	Semi-fitted	Frequency	16	14	3	11	3	13	60 (25.8)
		Expected	16.5	10.8	7.7	13.1	3.6	8.2	
		Column %	25	33.3	10.0	21.6	21.4	40.6	
	Loose fit	Frequency	3	5	0	12	2	3	25 (10.7)
		Expected	6.9	4.5	3.2	5.5	1.5	3.4	
		Column %	4.7	11.9	0.0	23.5	14.3	9.4	
Abdomen	Close fit	Frequency	38	19	16	17	7	6	103 (44.2)
		Expected	28.3	18.6	13.3	22.5	6.2	14.1	
		Column %	59.4	45.2	53.3	33.3	59.0	18.8	
	Semi-fitted	Frequency	13	13	11	20	5	15	77 (33.0)
		Expected	21.2	10.9	9.9	16.9	4.6	10.6	
		Column %	20.3	39.2	36.7	39.2	35.7	46.9	
	Loose fit	Frequency	13	10	3	14	2	11	53 (22.7)
		Expected	14.6	9.6	6.824	11.6	3.2	7.3	
		Column %	20.3	23.8	10.0	27.5	14.3	34.4	

TABLE 5.14: FREQUENCY TABLE OF FIT PREFERENCES OF PREDOMINANT AFRICAN AND CAUCASIAN BODY SHAPES CONTINUED

Body part	Fit preference		African triangle f = 64	Caucasian triangle f = 42	African hourglass f = 30	Caucasian hourglass f = 51	African rectangle f = 14	Caucasian rectangle f = 32	Total count (%) n = 233
Hips	Close fit	Frequency	44	21	25	30	11	20	151 (64.8)
		Expected	41.5	27.2	19.4	33.1	9.1	20.7	
		Column %	68.8	50.0	83.3	58.8	78.6	62.5	
	Semi-fitted	Frequency	16	16	5	5	2	7	59 (38.2)
		Expected	16.2	10.6	7.6	7.6	3.5	8.1	
		Column %	25.0	38.1	16.7	16.7	14.3	21.9	
	Loose fit	Frequency	4	5	0	8	1	5	23 (9.9)
		Expected	6.3	4.1	3.0	5.0	1.4	3.2	
		Column %	6.23	11.9	0.0	15.7	7.1	11.9	
Buttocks	Close fit	Frequency	46	22	27	42	10	19	166 (71.2)
		Expected	45.6	29.9	21.4	36.3	10.0	22.8	
		Column %	71.9	52.4	90.0	82.4	71.4	59.4	
	Semi-fitted	Frequency	9	14	2	6	1	11	43 (18.5)
		Expected	11.8	7.8	5.5	9.4	2.6	5.9	
		Column %	14.1	33.3	6.7	11.8	7.1	34.4	
	Loose fit	Frequency	9	6	1	3	3	2	
		Expected	6.6	4.3	3.1	5.3	1.4	3.3	24
		Column %	14.1	14.3	3.3	5.9	21.4	6.3	(10.3)
Thighs	Close fit	Frequency	42	19	27	31	11	12	142 (60.9)
		Expected	39	25.6	18.3	31.1	8.5	19	
		Column %	65.6	45.2	90.0	60.8	78.6	37.5	
	Semi-fitted	Frequency	12	10	2	13	2	13	52 (22.3)
		Expected	14.3	9.4	6.7	11.4	3.1	3.1	
		Column %	14.9	23.8	6.7	25.5	14.3	14.3	
	Loose fit	Frequency	10.7	13	1	7	1	7	39 (16.7)
		Expected	10.7	7.0	5.0	8.5	2.3	5.4	
		Column %	15.6	31.0	3.3	13.7	7.1	21.9	

Highest figures highlighted in yellow. Bold p-values significant at 5%

Table 5.14 records that a majority of the predominant African and Caucasian body shapes expressed a preference for closely fitted apparel at most of the selected body parts. The Caucasian hourglass, which is used by the apparel industry as a base for apparel manufacturing, cited apparel tightness around the stomach, waist, abdomen, hips and thighs. The Caucasian hourglass indicated dissatisfaction only with their abdomen and thighs; yet they showed a preference for a close fit at almost all the selected body parts (bust, waist, hips, buttocks and thighs).

The Caucasian triangle indicated a preference for a close fit at the selected body parts, which was unexpected, as they cited apparel fit problems of tightness at hips, buttocks and thighs, and were also dissatisfied with their hips, buttocks and thighs. The Caucasian rectangle expressed a preference for close fitted apparel at the buttocks (59.4%) and hips (62.5%); yet they reported fit problems of tightness and were dissatisfied with their hips and buttocks. It was unexpected that a majority of the Caucasian rectangle group who experienced apparel tightness at the bust (46.9%) would show a preference for closely fitted apparel. However, it should be noted that another 59.4% of the Caucasian rectangle group preferred a close fit at the bust. The Caucasian rectangle also reported a preference for semi-fitted apparel at the abdomen (46.9%), as expected, since they expressed dissatisfaction as well as fit problems at the same.

A majority of the three predominant African body shapes preferred a close fit at all the selected body parts, despite experiencing apparel fit problems as well as being dissatisfied with some of these body parts. The African hourglass reported apparel tightness at the waist, hips, buttocks and thighs as well as loose apparel fit at the hips. It was therefore unexpected when they expressed a preference for closely fitted apparel even at the parts where they cited fit problems. However, the close fit preference by the African hourglass could be attributed to the over 70% (African hourglass) who expressed being satisfied with all the selected body parts.

The African rectangle preferred closely fitted apparel at all the selected body parts; yet they were dissatisfied with their buttocks and experienced apparel tightness at the stomach, and were therefore expected to at least indicate a preference for semi- or loose fitted apparel at these body parts, as expected from the literature (LaBat & DeLong, 1990; Feather *et al*., 1996; Robinson, 2003; Chattaraman & Rudd, 2006; Plutt, 2011;). The literature further suggests that women with higher body cathexis choose fitted clothing to accentuate their bodies, and women with low body cathexis choose loose fitted apparel to conceal the body parts they are dissatisfied with (Rudd & Lennon, 2000), which was not the case in this study. Since this study focused on younger women aged 18 to 25 years and found that they preferred closely fitted apparel, despite being dissatisfied and experiencing apparel fit problems. These findings also confirm the fact that consumers' age would impact on their apparel fit preference (Keiser & Garner, 2012:84). In this study younger African and Caucasian apparel consumers showed a preference for closely fitted apparel at almost all the selected body parts.

5.10 INTERPRETATION OF THE RESULTS OF BODY SHAPE CHARACTERISTICS, PERCEIVED FIT PROBLEMS, BODY PART CATHEXIS, FIT PREFERENCES AND THE PERCEIVED IDEAL FIGURE OF AFRICAN AND CAUCASIAN WOMEN

It was reasoned in **Chapter 1** that there might be important body shape characteristic differences between young African and Caucasian women. It was also reasoned that, because of the fact that the Western ideal hourglass figure is still seen as the norm for the production and fit of apparel in the South African clothing industry, individuals with body shapes and body shape characteristics that differ from the ideal figure, may experience apparel fit problems. It was further reasoned from previous research that satisfaction with the body and body parts as well as the perception of what an ideal body shape looks like, may also impact on perceived fit problems, and vice versa. It was therefore decided to approach the problem of body shape differences and fit problems from a more holistic point of view.

It is clear from the summary of the results (**Table 5.15**) that all six body shapes that were identified as the most prevalent among young African and Caucasian women, perceived the hourglass shape as the ideal figure. The Western hourglass shape is also acknowledged as the ideal figure by the fashion industry, and becomes in many cases the norm against which young women compare their own body shapes (Pike & Rodin, 1991; Stice *et al*., 1994; Tiggemann & Pickering, 1996; Lin & Kulik, 2002). As is also still fashion, all the body shapes in this study, except for the Caucasian rectangular body shape, preferred a close fit at all selected body parts. Close fitted apparel follows the shape of the body, with little added ease. This may then result in more notable and serious fit problems in cases where the body shapes differ from the Western hourglass shape, specifically in the case of the rectangular body shape, whose straight body shape differs markedly from the shape of the hourglass body shape (Alexander *et al*., 2005; Rasband & Liechty 2006:210, 288, 314, 340, 342, 344).

TABLE 5.15: SUMMARY OF DIFFERENT BODY MEASUREMENTS, MEASUREMENT RATIOS, AND PREDICTED AND PERCEIVED

Analysis of body measurements	Caucasian hourglass	Caucasian triangle	Caucasian rectangle	African hourglass	African triangle	African rectangle
Circumferences	Assumed to be nearest to industry's ideal figure	Smallest bust	–	Smallest abdomen circumference	Smallest bust, largest hip, seat and thigh circumferences	–
Widths	–	Larger thigh width	Larger waist width	Smaller abdomen width	Smaller abdomen Larger thigh width	–
Protrusions	–	Smaller bust protrusion	–	Smaller abdomen protrusion	Smaller bust protrusion	–
Height	–	–	–	Shorter total body, bust and waist height	Shorter total body and bust height	Shorter total body and bust height
Circumferential ratios	–	Smaller bust-to-waist ratio Smaller bust-to-hip ratio Larger hip-to-waist ratio	Smaller bust-to-waist ratio Smaller hip-to-waist ratio	–	Smaller bust-to-waist ratio Larger hip-to-waist ratio Smaller bust-to-hip ratio	Smaller bust-to-waist ratio
Height ratios	–	–	Higher total body-to-waist height ratio	–	Lower total body-to-waist ratio	–
Predicted fit problems	–	Loose fitting apparel at bodice Tight fitting apparel at lower body	Tight fitting apparel at the waist	Loose fitting apparel around the abdomen	Loose fitting apparel at bodice Loose fitting apparel at waist Tight fitting apparel at lower body	–
Perceived fit problems	Tight fitting apparel at stomach, waist, abdomen, hips and thighs	Too tight fit at hips buttocks and thighs Too loose fit at bust	Too tight fit at: bust, stomach, abdomen, hips, and thighs	–	Too loose fit at the waist Too tight fit at hips, buttocks and thighs	Too tight fit at stomach and abdomen
Body part cathexis	Dissatisfied with stomach, abdomen, hips and thighs	Dissatisfied with hips, buttocks and thighs	Dissatisfied with stomach, abdomen, hips, buttocks and thighs	Satisfied with all selected body parts (>70% at all and 56% at stomach)	Dissatisfied with stomach and thighs	Dissatisfied with stomach, waist, hips and buttocks
Perception of ideal figure	Hourglass	Hourglass	Hourglass	Hourglass	Hourglass	Hourglass
Fit preferences	Close fit at all selected body parts except at the stomach and abdomen	Close fit at all selected body parts	Semi fit at abdomen	Close fit at all selected body parts	Close fit at all selected body parts	Close fit at all selected body parts

The results further revealed that there were six different body shapes prevalent, namely the African triangular (58.7%), hourglass (27.5%) and rectangular (12.8%) shapes, and the Caucasian hourglass (33.6), triangular (40.8%) and rectangular (25.6) shapes. When compared with the Western hourglass as the norm, it became clear that all of the other five body shapes differ significantly from the Western hourglass at selected body measurement points. That may then impact negatively on the fit of RTW apparel. It is clear that, except for the Caucasian hourglass shape where no fit problems were predicted from previous research and literature (Rasband, 1994:82, 130, 134; Alexander *et al*., 2005; Rasband & Liechty 2006:198, 210, 288, 296, 314), all the other shapes experienced fit problems, most of which were predicted. Contrary to what was predicted, the Caucasian hourglass shape that was assumed to be the nearest to the industry's ideal figure, experienced tight fitting at the stomach, waist, abdomen, hips and thighs, to the extent that it seems as if this shape might have chosen a too small size. The African hourglass, which has a shorter body and flatter abdomen than the Caucasian hourglass, did not experience the predicted loose fit around the abdomen. Petite/shorter sized apparel (which is generally not available in South Africa) might have given the shorter African hourglass a better fit.

As was anticipated from previous research and literature (Rasband, 1994:84; Alexander *et al*., 2005; Rasband & Liechty 2006:202, 210), both the Caucasian and the African triangle experienced a too tight fit around the hips, buttocks and thighs, while the Caucasian triangular shape also experienced a too loose fit in the bodice and the African triangular shape a too loose fit around the waist. The Caucasian rectangle experienced a too tight fit at almost all body parts, while the African rectangle perceived a too tight fit at the bust, stomach, abdomen, hips and thighs, even though no fit problems were predicted from the body measurements. It became clear that all six body types experienced a too tight fit in the lower body. It is interesting to note that, although they mostly experienced a too tight fit at the middle (stomach and abdomen) and lower body parts, that all the body shapes, except the Caucasian rectangular shape, preferred closely fitted apparel at all body parts.

The results further revealed that the African hourglass (who experienced the least fit problems) was satisfied with all body parts, while all other Caucasian and African shapes were dissatisfied with most of the lower body parts. Due to sparse cell counts it was, however, not possible to statistically determine associations between body part cathexis and predominant body shapes or body part cathexis and perceived fit problems. It should again be noted that, although all shapes (except the African hourglass) were dissatisfied with most of the lower body parts, they still preferred closely fitted apparel at all body parts.

The question is: How should these results, against the background of previous research and literature, be interpreted? Previous studies (Connell *et al.,* 2006; Bougourd, 2007:11; Shin & Istook, 2007; Lee *et al.,* 2007) found that ethnicity determine body shape and size, and that body shape characteristics differ from country to country. In an African context Mastamet-Mason (2008:167-68) determined major differences between the most prevalent Kenyan rectangular shape and the Western rectangular body shape, as well as perceived fit problems that could be attributed to the Kenyan rectangular shape's specific body characteristics. Mabuza (2012:103) determined that the triangular shape is the most prevalent shape among young Swazi women (54.5%), followed by the hourglass shape (34.7%). The researcher further determined that a basic dress that was made according to the measurements and shape of the Western ideal figure resulted in many more fit problems, compared to a dress that was made according to the shape of the most prevalent triangular Swazi shape. The present study found not only body shape differences within young Caucasian and African consumer groups, but also significant body shape characteristic differences between the same shaped African and Caucasian women. This strongly points to the role of ethnicity in body shape differences. The study also found major differences between the established body shapes and the assumed ideal Western hourglass shape that could result in fit problems.

Many previous studies reported perceived clothing fit problems among women of all ages that could be attributed to specific body shape differences and differences between specific body shape characteristics (Yu, 2004:31-33; Ashdown, 2003; Otieno *et al.,* 2005). Alexander *et al.* (2005) found that females with self-reported rectangular or inverted triangular shapes, reported the most fit problems, while LaBat and DeLong (1990) found in their study that female consumers reported more fit problems for the lower body than for the upper body. In an African context, Mastamet-Mason (2008:230) found that most Kenyan career women experienced fit problems in the upper and lower body, while Nkambule (2010:82) found that triangular shaped plus-size Swazi women experienced serious fit problems at the waist, abdomen, hips and buttocks. Except for the African and Caucasian hourglass shape, all the other shapes in the present study reported fit problems most of which were anticipated for the specific body shape. Specifically the Caucasian rectangular shape, whose shape strongly differs from that of the ideal Western/Caucasian hourglass shape (which is still taken as the norm by the South African clothing industry), even though body measurements did not reveal that in the present study, reported fit problems at almost all the body parts. This confirms that body shapes and body shape characteristics that differ from the body shape of the Western/Caucasian hourglass shape, result in fit problems for the female clothing wearer.

Previous studies expressed support for the argument that body size and shape, body image and cathexis, and fit preferences cannot be separated (LaBat & DeLong, 1990; Markee, Carey & Pedersen, 1990; Rudd & Lennon, 2000; 2001; Chattaraman & Rudd, 2006), while some research also pointed to the role of the ideal figure and the comparison with the ideal figure in women's body image and body satisfaction (Lin & Kulik 2002; Webster & Tiggemann, 2003). Webster and Tiggemann (2003) found that young women in their early twenties experienced lower body satisfaction when confronted with the thin Western ideal shape (Tiggeman & Pickering, 1996; Robinson, 2003; Keiser & Garner, 2003:31; Grippo & Hill, 2008; Keiser & Garner, 2012:84). In a South African context, Grebe (2011:93-110) found body shape an important aspect in young African women's beauty ideal, and that it was of the utmost importance for these women that their clothes should fit their bodies beautifully. The researcher also found that, when confronted with Western-inspired, African-inspired and Euro-African-inspired fashion images, these young African women tended to compare themselves more to the curvy Euro-African image, than to the Western and African images. In the present study the hourglass shape (propagated as the ideal shape by the media) was chosen by all six body shapes as the ideal body shape. Against previous research (Robinson, 2003) and the social comparison theory (Lin & Kulik, 2002), it could be argued that the hourglass shape is therefore also the shape that the various African and Caucasian shapes in this study would have compared themselves with. It is therefore interesting to note that only the African hourglass in the present study was satisfied with all the selected body parts!

Various previous researchers studied the influence of body image and body cathexis on fit preferences (Pisut & Connell, 2007; Manuel *et al*., 2010; Chattaraman *et al*., 2013), but a few concentrated on the association between body cathexis and fit problems. It should also be noted that in these studies, body shapes of respondents were self-reported and not scientifically determined as in the present study. In the present study all the body shapes, except the African hourglass shape, reported dissatisfaction with their middle and lower body parts and specifically the stomach/abdomen, hips, buttocks and thighs. These were also the body parts where they reported fit problems and where fit problems were predicted due to differences between the specific shape and the Western hourglass shape. However, due to sparse cell counts it was not possible to determine associations between satisfaction with specific body parts and reported fit problems in the present study. LaBat and DeLong (1990) found statistically significant correlations between satisfaction with lower body parts and satisfaction with fit. It should, however be noted that body shape and thus also predicted fit problems due to body shape, were not factors in their study. LaBat and DeLong (1990) therefore only confirmed a relationship between satisfaction with fit and cathexis towards the personal body, and not that the feelings towards the personal body are influenced by perceived fit problems. Mastamet-Mason (2008:230), just like LaBat & DeLong (1990) found that Kenyan women who reported fit problems tended to blame their own bodies for the problems!

Although it was in the present study, due to sparse cell counts, not in all cases possible to determine associations between the many variables, the results clearly point to the role of body shape in perceived fit problems and that it may influence satisfaction with selected body parts. A future study with a larger sample that also employs alternative statistical analyses, could prove a strong path between body shape, fit problems and satisfaction with specific body parts and fit preferences. Implications for the clothing industry are discussed in **Chapter 6**.

CHAPTER 6: CONCLUSIONS, EVALUATIONS, CONTRIBUTION TO THEORY AND RECOMMENDATIONS

6.1 INTRODUCTION

This chapter presents the conclusions drawn from the findings of this study, an evaluation of the research process followed and how the study assured quality of results and repeatability of the research process in the future, the contribution of the concepts being explored to the existing body of knowledge, as well as recommendations for further research and those emanating from the findings of this study. The objectives of this study were:

- To identify, categorise and compare the body shapes prevalent among African and Caucasian women using measurements and three-dimensional scan images
- To determine and describe the association between body shapes and ethnicity
- To describe and compare visual scan images, selected body measurements and measurement ratios of young African and Caucasian women
- To determine and describe significant differences in selected body measurements and measurement ratios of predominant African and Caucasian body shapes
- To determine and describe perceived ready-to-wear apparel fit problems encountered by predominant African and Caucasian body shapes on selected body parts To determine and describe body part cathexis of young African and Caucasian women
- To determine and describe ready-to-wear apparel fit preferences of young African and Caucasian women

6.2 CONCLUSION

From the findings of this study it was evident that the drop values of bust minus waist and hip minus bust circumferences, and the visual analysis of scan images can successfully be used to respectively classify and verify the body shapes of young African and Caucasian women. It can be concluded that the most prevalent body shapes among the African ethnic group were the triangle (58.7%), hourglass (27.5%) and rectangle (12.8%), and among Caucasian women the hourglass (40.8%), triangle (33.6%) and rectangular (25.6%). The findings of the present study confirm variability in body shape prevalence among women of different ethnicity, as was observed in other studies that classified women from different populations (Lee *et al*., 2007; Shin & Istook, 2007; Mastamet-Mason, 2008:151; Mabuza, 2012:103). This study reveals that body shape prevalence differed among African and Caucasian participants, proving an association between body shape and ethnicity.

The present study found the triangle and hourglass to be the two most prevalent shapes among African and Caucasian women in varying numbers respectively, followed by the rectangle shape. This was contrary to what was found in Western and non-Western populations where the rectangle was the most prevalent body shape among USA women of different ethnicities and ages, Korean women of all ages and Kenyan women aged 25 to 55 years. It can further be concluded that there were significant variation in the body dimensions and body shape characteristics between similar shaped African and Caucasian women, between different body shapes within the same ethnic groups, and between the Caucasian (Western) hourglass and the predominant African and Caucasian body shapes. This was evident as the African triangular shapes have significantly larger thighs, shorter total body-to-waist and total body-to-hip height ratios than the Caucasian triangle; the African hourglass group have significantly smaller abdomens, were also significantly shorter, with shorter bust and waist height dimensions than the Caucasian hourglass; and the African rectangular group have significantly shorter total body to waist height ratios than the Caucasian rectangle. It can be concluded therefore that ethnicity influences body shapes and body shape characteristics of African and Caucasian women.

This study further revealed significant differences in body measurements of the three predominant African and three predominant Caucasian body shapes. African and Caucasian triangular shapes have significantly larger lower bodies (hip, buttocks and thighs) than the African and Caucasian hourglass. Caucasian triangular shapes also have significantly smaller bust than the Caucasian hourglass. These differences subsequently resulted in different circumferential ratios. This study therefore concludes that female consumer populations of the same ethnicity differ in body shape and body shape characteristics. The apparel industry should therefore identify and base their RTW apparel manufacturing on body shapes and sizes that are representative of their target markets.

The body measurements of African and Caucasian predominant body shapes were compared to those of the Caucasian hourglass that is used by the apparel industry for manufacturing RTW apparel. The findings of the present study indicate that African and

Caucasian triangular shapes have significantly smaller upper body part (bust) and larger lower body parts (hips, buttocks and thighs) than the Caucasian hourglass; African triangular shapes also have a smaller abdomen than the Caucasian hourglass. The three African body shapes are significantly shorter and also recorded shorter bust and waist height dimensions. Caucasian triangular shapes have a significantly larger waist. It can be concluded therefore that the predominant African and Caucasian body shapes differ significantly from the Caucasian hourglass shape. This study then could predict the fit problems each predominant body shape is expected to experience at the body parts that differed significantly from the Caucasian hourglass that is used to manufacture RTW apparel.

The findings of this study indicate that some of the fit problems reported were due to significant differences in body measurements between the Caucasian hourglass and the predominant African and Caucasian body shapes, namely the African and Caucasian triangle, and the Caucasian rectangle. As predicted, due to their significantly smaller bust and larger hips, buttocks and thighs than the Caucasian hourglass, the African and Caucasian triangle expressed problems of loose fitting apparel at the bust and tight fitting apparel at the hips, buttocks and thighs. It can be concluded therefore that the African and Caucasian triangular shapes would experience apparel fit problems on the body parts that differ significantly from the standard figure (Caucasian hourglass). It should also be noted, however, that the African and Caucasian rectangle cited fit problems that were not predicted from the significantly different measurements. The Caucasian rectangular shapes have a larger waist and the African triangular shapes have smaller circumferential and shorter height ratios than the Caucasian hourglass. Due to their larger body that is almost equal from the bust to the hips, the African and Caucasian rectangle reported apparel tightness at the mid-section, i.e. stomach and abdomen; the Caucasian rectangle also cited apparel tightness at the bust, hips and thighs. These findings point to other factors influencing fit perception apart from body shape and body shape characteristics and the fact that apparel fit is subjective. Therefore, it can be concluded that African and Caucasian rectangle experienced apparel tightness at almost all the selected body parts. Furthermore, the fit problems reported by the different body shapes show that the sizing system currently used in South Africa does not cater for the different ethnic groups, nor for the different body shapes prevalent within each ethnic group. It can be concluded therefore, that the continued use of the standard figure (the Caucasian/Western hourglass) by the South African apparel industry resulted in fit problems, as reported by the African and Caucasian triangle and the African and Caucasian rectangle that recorded a number of significantly different measurements from the Caucasian hourglass. It would therefore be unrealistic for the apparel industry to continue manufacturing styles that are suitable for the hourglass body shape and expect them to give satisfactory fit to all the other body shapes. Especially because among the young African and Caucasian women a majority of the participants were hourglass, triangular and rectangular shaped. Therefore in order for the South African apparel industry to give better fit to a majority of the young African and Caucasian women, they should base pattern making and apparel production on the measurements of the predominant body shapes among the young African and Caucasian women, i.e. the hourglass, triangle and rectangle shapes. Since the measurements and body shape characteristics of similar body shapes differed according to ethnicity, each body shape should have different base patterns for the different ethnic groups. Moreover, it is also evident from the findings that the apparel fit needs of the ethnically diverse South African female consumer population cannot be satisfied by the use of one standard figure, as it was evident from the fit problems reported in this study.

This study further indicates that almost all the predominant African and Caucasian body shapes were dissatisfied with their mid-section (stomach, waist and abdomen) and their lower body parts, namely hips, buttocks and thighs (except the African hourglass). The Caucasian triangular shapes were dissatisfied with their larger lower bodies, the African and Caucasian rectangular shapes were dissatisfied with their fuller mid-section (stomach, waist and abdomen) and larger lower bodies. It also can be concluded that the African hourglass shape was the most satisfied group, as they were satisfied with all the selected body parts, whereas the Caucasian rectangle group were dissatisfied with most of the selected body parts. This study could not test the relationship between body part cathexis and ethnicity, fit problems, body shapes and body shape characteristics, due to the sparseness of the data. However, from the findings of the study it can be concluded that the body shapes of the African and Caucasian body shapes influenced African and Caucasian women's level of satisfaction with the selected body parts. This was evident as participants of different body shapes reported dissatisfaction with more or less the same body parts, despite having different body shape characteristics. Furthermore, experiences of fit problems at the selected body parts and significant differences in body measurements from the Caucasian hourglass also did not seem to influence participants' body part cathexis. However, ethnicity seems to have influenced cathexis, since the African hourglass group were more satisfied with all their selected body parts than the Caucasian hourglass group, and the Caucasian triangle group were dissatisfied with more of the selected body parts than the African triangle group.

The present study found that all the predominant body shapes expressed a preference for closely fitted apparel. It can be concluded therefore that young African and Caucasian women of different body shapes prefer closely fitted apparel at all the selected body parts, despite variations in body measurements and body shape characteristics, experiences of fit problems and dissatisfaction with selected body parts. These findings point towards other factors influencing apparel fit preference such as age, which was not tested in this study.

6.3 EVALUATION OF THE RESEARCH

Evaluation of this research is conducted to ensure the quality (validity and reliability) of the results obtained and to determine whether the research could be successfully repeated in future research. This section of the research evaluates and justifies the research design used, the choice of sampling techniques and research sample size, the choice and application of data collection methods, the choice of statistical methods used, as well as how the overall reliability and validity of the study were ensured.

6.3.1 The research strategy followed

This study was conducted according to the dictates of the quantitative research methodology (where possible). The scope and objectives of this study dictated that a cross-sectional, quantitative exploratory and descriptive research design be utilised. Quantitative research is an inquiry into an identified problem, based on testing a theory, measured with numbers and analysed using statistical methods. In this study the researcher did not interfere with the concepts and variables being researched, as quantitative methods require; this ensured the quality of the research. The exploratory and descriptive aspects of this research respectively brought an understanding of body shape characteristics, perceived RTW apparel fit problems, body cathexis and fit preferences of young African and Caucasian women which are relatively new and persistent issues impacting on apparel fit.

The quantitative methodologies allowed the use of measurement procedures that resulted in the collection of numerical data. The data in this study was collected using the NX-12 [TC]^2 full body scanner, which is currently the most reliable body measurement method. Furthermore, reliable, tried and tested data collection instruments and scales were used, i.e. the body cathexis scale, the Body Shape Assessment Scale and a questionnaire. The body cathexis scale was first formulated in 1953 (Secord & Jourard, 1953**)** and has been modified and adapted over the years. The Body Shape Assessment Scale and questionnaire were formulated based on pre-determined standards of body shape classes as well as body shape descriptors identified from an in-depth literature review. Key concepts were also identified from the literature review and were used to formulate items and questions. These measures assured the quality of the instrument and the data collected.

6.3.2 Choice of the research sample

Quantitative research requires a larger sample size that is selected using probability sampling techniques to allow the conclusions drawn from the findings to be generalised to the entire population. However, in this study non-probability sampling techniques (purposive and snowballing techniques) were employed to obtain a sub-sample from each ethnic group, totalling to n = 234 participants (109 African and 125 Caucasian women). These sampling techniques allowed a balance in the inclusion of participants in the absence of a sampling frame and it was also an inexpensive way to ensure sufficient participation in the study. This was also appropriate in the selection of a sample to describe and compare the body shapes, fit problems, body cathexis and fit preferences of the participants. The sample size of this study (n = 234) was reached based on sample sizes successfully used in previous studies that utilised scan data (Connell *et al.,* 2002; Connell *et al*., 2006; Devarajan & Istook, 2004; Simmons *et al*., 2004a; 2004b). Furthermore, Mastamet-Mason (2008:146) with an almost equal sample size, successfully conducted a study that followed similar methodologies in classifying body shapes and investigating apparel fit problems of Kenyan women.

Even though a 3-D body scanner is a quick method that could obtain measurements of a large sample within a short time, due to the limited time which it was available to the researcher, only the sampled participants could be scanned. Universities are some of the places where a large number of young (in this case) African and Caucasian women could be accessible. Therefore, a majority of the subjects in the present study were students from two large Universities (the University of Pretoria and the Tshwane University of Technology) in Tshwane, formerly Pretoria, and a major metropolitan city in South Africa.

The Generation Y (18 and 25 years) consumer segment spends more than half the allowance received from parents plus money earned from part-time jobs on clothing. South African households with dual or single parents have become smaller career-oriented families with a lot of disposable income, and respond positively to the Generation Y consumers' demands for clothing (Oliver, 2007). The Generation Y consumers are fashion conscious and therefore seek fashionable apparel that is flattering, makes them look attractive and enables them to show off their physical attributes, to satisfy emotional needs and to impress and be accepted by their peers. They purchase new clothes to feel trendy and may discard wearable clothes as soon as they are out of fashion. All of these attributes make them a viable RTW apparel market worth exploiting.

The researcher requested voluntary participation from students who possessed the qualities sought in the study. The participants also recruited more subjects by word of mouth through the snowballing technique. The purpose, objectives of the study as well as the data collection procedures were explained to potential participants. They were assured of confidentiality and anonymity of the information gathered through body scanning and questionnaire (Rubin & Babbie, 2007:167). The whole data collection process was explained to the participants and they were also reassured that body scanning was not harmful as it used white light (Yu, 2009). Participants were requested to participate in both body scanning and questionnaire completion for complementary and useful data. All the information obtained from one subject, i.e. the questionnaire, scan data and body shape assessment scales, had the same code to eliminate chances of data mix up and confusion, which also contributed to the quality of the data.

6.3.3 Choice and application of data collection techniques

The data collection instruments were pilot tested on a convenience and purposively selected sample of 50 students (25 African and 25 Caucasian) who possessed similar characteristics as the final sample. Thereafter experts with over 10 years of experience in clothing and textiles and apparel sizing and fit, lecturers in the Department of Consumer Science: Clothing Management section and statisticians at the University of Pretoria scrutinised and critiqued the questionnaire, after which the necessary modifications were effected to ensure language clarity, validity and reliability. This ensured the collection of quality data on participants' fit problems, body cathexis as well fit preferences reported at each of the selected body parts. It is for that reason that descriptive-exploratory research was viewed as appropriate for this study.

6.3.4 Quality of data collected using questionnaire

Questions in the questionnaires were formulated based on the objectives of the study. Important concepts on body shapes, apparel fit problems, body cathexis and apparel fit preferences were identified from an in-depth literature review, ensuring that theoretical constructs addressed the objective and the problem statement. The use of structured, closed-ended questions in the questionnaire as well as the use of categories in scales (Likert, body cathexis and nominal scales) allowed quantification of data, as required in descriptive quantitative research. These ensured the quality of the data as it resulted in more uniform answers that were easy to process. A dress/body form labelled with the selected body parts was provided to help participants to correctly locate technically unfamiliar body parts like the crotch, and to locate and differentiate between stomach, waist and abdomen as well as hip, seat and thigh. The use of a questionnaire in this study also ensured anonymity of participants as it was coded, and this ensured that participants were at ease to give accurate information, which consequently gave quality data.

6.3.5 Quality of data collected using expert sensory evaluators

The two trained expert sensory evaluators were selected based on their vast experience of over 10 years in clothing and textiles and apparel sizing and fit. They were trained on body shape descriptors and how to visually analyse and compare participants' bust, waist and hips on the front and side views of the virtual images to verify figure shapes assigned, using measurements. The experts used the Body Shape Assessment Scale (**Addendum 3**) that was designed based on body shape descriptors that were identified and summarised from the literature (Simmons *et al*., 2004a; 2004b, Lee *et al*., 2007; Mastamet-Mason, 2008:). Each participant was assigned a body shape after both experts reached a consensus. Their vast experience, training and the use of the Body Shape Assessment Scale to assess scan images and confirm the body shapes classified from the measurements, contributed to the quality the data.

6.3.6 Quality of data collected using $[TC]^2$ NX-12 version 7.2 3-D body scanner

Prior to data collection, the researcher underwent training on how to operate a $[TC]^2$ NX-12 Version 7.2 3-D body scanner to extract body measurements and virtual body images. The training ensured the reliability of the scanning method and extraction of measurements, which was the basis for the classification of the African and Caucasian body shapes. The NX-12 Version 7.2 3-D body scanner was erected in the data collection venue and the system was calibrated, tested and verified in readiness for scanning. The scanner was also calibrated every morning to ensure the accurate capturing of virtual images and consequently, the correct extraction of measurements.

The scanning cubicle was sealed with a thick black felt curtain that was held in place by Velcro and weighted hems to ensure that no light passed through, as light interferes with the quality of the scan images and consequently the accuracy of the extracted body measurements. The scanning process was quick as it took an estimated 54 seconds per scan image. Subjects were allowed to rest in between scans to prevent fatigue and to enable the researcher to assess the quality of the scan images before saving them. The quick scanning and rest in between scans minimised fatigue that might have resulted in shifts in body posture and subsequently faulty body measurements. Assessing the scan images before saving them eliminated errors emanating from poor scan quality and faulty extraction of body measurements and therefore missing data.

The subjects were each given well-fitting scanning garments according to their body build and RTW apparel size. The scanning garments were sewn from a stretchy fabric and were worn over every day well-fitting undergarments with good support. Participants with long hair and braids tied them up away from the neck. All of these preparations ensured a smooth silhouette to enhance the quality of the scan images and consequently the extraction of accurate measurements.

The four scan images that were captured per participant minimised the chances of missing data from distorted scan images and assured the extraction of accurate body measurements from all the participants. This also ensured that the measurements were extracted uniformly and consistently from all participants. The different postures allowed for the extraction of accurate measurements as well as the assessment of participants' body shapes by the expert visual evaluators, and subsequently, accurate verification of the body shape assigned from the measurements.

The body measurements were automatically extracted according to the $[TC]^2$ landmark locations, which minimised human error and enhanced the scan data quality. Furthermore, all the scan images were assessed to determine whether the body measurements were extracted correctly. The NX-16 Version 5 software allowed for the manual correction of measurements that were initially extracted at wrong locations, which contributed to the quality of the data. The wrong location of measurements was observed among the few fuller figured participants. Measurements of the African and Caucasian women were then electronically transferred to an Excel file, which eliminated human error.

6.3.7 Achievement of objectives of the study

The research objectives that guided the execution of this study were outlined in **Chapter 1**. The primary objectives and sub-objectives formed the basis for the formulation of questions in the questionnaire and the items in Body Shape Assessment Scale as well as the selection of body measurements. This enabled the collection of relevant data and analysis and interpretation of findings, and consequently reaching meaningful conclusions relevant to the objectives of the study. It can be safely said that the primary and sub-objective set out at the beginning of the study were adequately addressed, and from the findings of this study conclusions were drawn and recommendations were made for a number of areas of relevance and future research.

6.4 THE CONTRIBUTION OF THE STUDY TO EXISTING THEORY

6.4.1 Body shape and ethnicity

Since there is no sizing system that is based on the body measurements and body shapes of the ethnically diverse South African population, the local industry's apparel offerings do not meet the fit needs of the population. This study shows that women of different ethnic groups have different body measurements, body shapes as well as body shape characteristics. The continued use of foreign sizing systems and standard figure in the manufacturing of RTW apparel in South Africa is the main cause for ill-fitting apparel among female consumers. Previous studies emphasised the need for a representative South African Anthropometric data base (Strydom, 2006). The current study provides anthropometric data of the predominant African and Caucasian body shapes captured using 3-D body scanning. Furthermore, **Table 4.1** outlines the body measurements extracted and locates landmarks and body locations for each measurement. This information is a starting point in addressing the challenge identified by Strydom, (2006) that the South African apparel industry needs a consensus of where body measurements should be taken and how.

This study also found that the body measurements of a number of predominant African and Caucasian body shapes differed significantly from the Caucasian hourglass which is used by the apparel industry as a design base for RTW apparel production. The findings of the current study confirm what was found by previous studies that body shapes and proportions vary by ethnicity. Shin and Istook (2007) found significant body dimension and shape differences between Caucasian, African-American, Hispanic, Mexican-American and Asian women. They found that Asians have the smallest body dimensions while Caucasians and African-Americans differ significantly in the lower body dimension categories. Lee, Istook and Park (2007) found that, although the rectangular shape was the most prevalent shape in America and Korea, the body proportions of rectangular shaped American and Korean women differed significantly. The USA women had higher measurements in the waist, high hip and hip height and larger measurements in the bust, waist, high hip and hip circumference. In their study Lin, Wang and Wang (2004) also found significant differences between the body dimensions of people from four different Eastern countries, namely China, Japan, Korea and Taiwan. In an African context Mastamet (2008) found that the rectangular shape is the most prevalent female Kenyan shape, but that the Kenyan rectangular shape differs from the American rectangular shape. While the American rectangular shape appears straight from the shoulders to the hips, the Kenyan shape appears curvier around the hips and thigh areas with a well-defined thigh bulge and a longer waist to hip distance. In another African study Mabuza (2012) found that amongst young African Swazi women, the most prevalent female Swazi shape is the triangular shape with a small upper body and a heavy lower body with rounded buttocks and hips. With the findings of these previous studies as well as the findings of the current study in mind, it is therefore evident that the industry must consider basing its apparel manufacturing on the body measurements of the most prevalent body shapes among the different ethnic groups in South Africa.

The body measurements captured and the body shapes identified among young African and Caucasian women could be a starting point for the South African data base to which the measurements and body shapes of the other ethnic groups may be added, and thereafter, customised size charts may be the bases on which the much anticipated South African sizing system may be developed. The findings of this study could also form a research base to benefit the South African apparel research in apparel sizing, as already evidenced in a study by Muthambi (2012) who successfully used preliminary data from this research to develop proposed sizing for the African triangular shape group. This is an indication that findings of the current study will contribute to the existing theory of sizing as the findings from the other predominant African and Caucasian body shapes could be utilised in the same research area as Muthambi (2012) as well as numerous other research areas. This study also contributes methodologies used that could also be utilised in further research on the apparel fit of the other ethnic groups.

6.4.2 The body shape classification methodology

The use of the 3-D body scanning technology in RTW apparel manufacturing in South Africa is still at its infancy and needs further exploration for scientific research. While there are a number of studies abroad that classify and compare body measurements, shapes and body shape characteristics prevalent within different ethnic groups, in South Africa this is an area that is not well researched. In South Africa there is lack of published anthropometric data and body shapes prevalent among the ethnically diverse female consumer population. This study contributed anthropometric data of the African and Caucasian women. From the accurate body measurements extracted using 3-D body scanning technologies, this study was able to analyse and classify the body shapes of African and Caucasian women. There has not been any documented scientific research in the area of body shape classification of the ethnically diverse South African female consumer population. The findings on anthropometric data of the different body shapes form a basis for further research on customised size charts for designing and producing of RTW apparel with improved fit for the predominant African and Caucasian body shapes, as a starting point for consumer-specific RTW apparel production in South Africa. This study successfully used Mastamet- Mason’s (2008) methodology where a combination of drop values, minimum and maximum measurements differentiated body shape classes using the Mean ± Standard Deviation specific to body measurements of the specific sample are used. This study therefore confirmed that body shape defining parameters should be based on measurements of the population being classified.

Findings of the comparison of body measurements and of body shape characteristics of predominant figure shapes that emerged from this study are an indication that this study serves as a starting point for large scale follow-up studies to allow generalisation of findings to be used by the entire South African apparel industry. This study found a significant association between body shape and ethnicity, as predicted from previous literature. While there have been research conducted abroad comparing body measurements, body shapes and body shape characteristics of ethnically diverse women, the current study contributes to an un-researched area within the South African female consumer population.

6.4.3 Apparel fit theory

Ashdown's model was adapted and used as the theoretical framework for this study. The model identifies the main factors affecting sizing systems and consequently the fit of RTW apparel. These are the population measures (body measurements of a population), the design features (construction of apparel), the fit issues and the communication of sizing and fit between manufacturer and consumer through size labelling, and the consumer's post-purchase reaction. The Ashdown's model, suggests that the starting point of any sizing system should be accurate and up-to-date body measurements captured, using reliable methods such as the 3-D body scanning. The 3-D scanning technology method of taking body measurements is still unfolding in the South African RTW apparel industry. This study came up with anthropometric data for each of the predominant African and Caucasian which are a meaningful contribution to the existing fit theory in South Africa. This data may be a starting point and be used for further research in an attempt to address fit problems experienced from standard apparel. This information may be useful in providing the South African market with apparel that targets and serves the ethnically diverse population better.

Furthermore, the body shapes of African and Caucasian women were classified from measurements and virtual images. Moreover, to date, 3-D body scanning is the most reliable method of measuring the body. The body shape classification methods adopted in this study were based on and are specific to measurements of the sampled participants and generalisations cannot be made. Currently, manufacturers base RTW apparel designs, styling and manufacturing on measurements and shapes of the standard (Western/Caucasian) figure thus compromising RTW apparel fit, whereas literature suggests that apparel production should aim at accommodating the predominant body shapes within the population. Findings of this study prove body measurements and body shapes variability by ethnicity. Furthermore, all the predominant shapes identified in this study differed significantly from the Caucasian hourglass. In addition, they cited fit problems at most of the selected body parts as predicted from the significantly different body measurements and literature, even though some of the fit problems predicted from these significant differences could not be confirmed by the consumers' perceived fit problems. This is an indication that differently shaped consumers require base patterns similar to their body shapes to achieve improved apparel fit. The findings of this study bring the variability of body measurements and the body proportions of the Western/ Caucasian hourglass and the predominant African and Caucasian body shapes to the attention of the South African apparel manufacturers and retailers.

Previous research conducted outside South Africa was focused on RTW apparel fit for the upper and lower body. This study gives an understanding of the specific body parts where each of the predominant African and Caucasian body shapes experience fit problems. This information will be useful to the South African RTW apparel manufacturers, who will be in a better position to rectify and minimise fit problems throughout the pattern development and garment production stages. Anthropometric data of the predominant body shape categories may be useful in fit tests that are conducted on fit models and body forms with body shapes that are representative of those prevalent within a population. Strydom and De Klerk (2006) observed that RTW apparel (in South Africa) does not specify the body measurements and body shapes of the consumers it is designed to fit. Therefore, to minimise fit problems, the communication of sizing and fit should be based on the body measurements and body shapes of the targeted population. This study provides body defining parameters and measurements for the different predominant African and Caucasian body shapes that can be utilise by consumers in their quest to identify their body shapes. Knowing their body shapes will enable them to meaningfully utilise size labels to eliminate fit problems emanating from consumers' lack of knowledge on how to identify their body shapes. When apparel consumers make informed apparel selection decisions according to their measurements and body shapes, some of the fit problems may be eliminated.

6.4.4 Body cathexis theory

The literature (LaBat & DeLong, 1990; Feather *et al*., 1996; Robinson, 2003; Chattaraman & Rudd, 2006) reveals that body cathexis influences consumers' apparel fit needs. Apparel fit preference may also be impacted by the level of satisfaction with one's body (body cathexis) and its physical dimensions or apparel size. Apparel consumers tend to compare themselves with the slimmer ideal body, resulting in negative body cathexis and subsequently dissatisfaction with RTW apparel fit. Generally women are dissatisfied with their lower body. The young African and Caucasian women in this study's sample were no exception. In contrast, Chattaraman and Rudd (2007) show that upper body parts usually record higher body cathexis and fit satisfaction. Research reveals that consumers with average body sizes are more satisfied with their bodies as well as their apparel fit than larger women, who exhibit less satisfaction with both their bodies and clothing fit (Fan, 2004:33). A study by LaBat and DeLong (1990) also confirmed that women who are generally dissatisfied with their lower torso were also dissatisfied with apparel fit on the lower body.

Several studies indicate a positive correlation between body cathexis and apparel fit preference (Grogan, 1999; Chattaraman & Rudd, 2006; Robinson, 2003). The same studies reveal that a number of women are dissatisfied with their abdomen, hips, thighs and buttocks, which in most cases are larger than in an average figure. They are also likely to prefer loose apparel fit at these body parts. Moreover, body shape is one of the main determinants of a woman's perception of her physical attractiveness (Body cathexis). If they are dissatisfied with body size and shape, women may use clothing to compensate for their dissatisfaction with their bodies (LaBat & DeLong, 1990; Robinson, 2003; Grippo & Hill, 2008). Hence they will select looser apparel on the areas where they are dissatisfied.

The findings of the same studies (Grogan, 1999; Robinson, 2003; Chattaraman & Rudd, 2006) reveal that consumers who are satisfied with their bodies or certain parts thereof are likely to prefer closely fitted apparel (Alexander *et al*., 2005). Devarajan and Istook (2004) reveal that fit preference is also influenced by age. According to a study conducted in the United States, (Song & Ashdown, 2012), younger fashion conscious women preferred a close fit. In contrast, mature older women preferred loose fitting apparel since their priority is apparel comfort over fashion image. In an African context Nkambule (2010) found the same results with regard to younger and older Swazi women. It is also recorded (Robinson, 2003; Apeagyei *et al*., 2007; Boyington *et al*., 2007; Grippo & Hill, 2008) that satisfaction with one's body is influenced by how much one's body deviates in actual body size and shape from the figure considered to be ideal. The more the body deviates from the ideal body, the lower the body cathexis.

This study revealed some interesting results with regard to body cathexis and ethnicity. Taking into account that young Generation Y respondents are generally fashion conscious, one can assume that they would be aware of the popularity of the Hourglass Western body shape as the preferred fashion shape, and would also be aware of major differences between their own body shapes and that of the ideal shape. When asked which shape they perceive as the ideal shape more than 50% of all six shape categories in this study perceived the hourglass shape as the ideal shape. It is, however, interesting that the smallest percentages of both the African Triangular shape (56.3%) (who differs markedly from the Western Hourglass shape) and the African Hourglass shape (53.3%) (with also an Hourglass shape) perceived the Western Hourglass shape as the ideal shape. It is further interesting to note that the African Hourglass were in the end satisfied with all their body parts (in some cases above 70%), while the Caucasian Hourglass that resembles the ideal figure were in the end dissatisfied with their the stomach, abdomen, hips and thighs (and also report fit problems at these points)! The African Triangular shape, on the other hand, who differed markedly from the Western Hourglass shape, but did not to the same extent perceived the Western Hourglass as the ideal figure, expressed minor dissatisfaction with only the stomach (45.3%) area and the thighs (where equal percentages were satisfied and dissatisfied).

Quite a number of previous studies have studied the role of ethnicity in body cathexis. Results of most of these studies suggest that African women are more satisfied with their bodies than Caucasian women (Ackard, Croll & Kearney-Cooke, 2002; Barry & Grillo, 2002; Siegel, 2002) (and might thus in the end also perceived fewer fit problems!). Other studies also found differences between Caucasian and Hispanic women's body dissatisfaction, with Caucasian women being reported as more dissatisfied (Demarest & Allen, 2000; Suldo & Sandberg, 2000). Streigel-Moore, Schreiber, Pike, Wilfley and Rodin (1995) found that Black girls were more satisfied with their bodies despite the fact that they were bigger and heavier than Caucasian girls. One should therefore also acknowledge the role of ethnicity in what is perceived as beauty or ideal (as is also reflected in the results of this study). Most people strive to achieve a specific ideal of beauty that is popular and accepted in their specific culture and social group (Englis, Solomon & Ashmore, 1994; Johnson, 2008). What is perceived as beautiful or ideal in one culture may therefore not be perceived as beautiful or ideal in another culture and would then therefore not serve as the ideal standard for comparison. Parker, Nichter, Nichter, Vuckovic, Sims and Ritenbaugh (1995), found, for example, that African American females were more flexible than Caucasian Americans in their concepts of beauty and spoke about "making what you've got work for you", while Evans and McConnell (2003) found that African women did not find mainstream beauty standards as relevant for comparison and reported positive self-evaluations about their bodies. In a South African context Grebe (2011) found that it is important for Generation Y African women to be recognised as an individual with their own personalities, rather than for a Westernized fashion style or beauty ideal. Although it was in the current study, due to sparse cells, unfortunately not possible to determine relationships between body cathexis and other variables, results nevertheless point to the role of perceived ideal in body cathexis and perceived fit problems, and therefore also the necessity for further research in this regard.

6.4.5 Fit preferences theory

Another factor that needs to be taken into account when RTW apparel is produced is consumers' fit preferences. Previous research conducted abroad (Keiser & Garner, 2003:31; Alexander *et al*., 2005; Pisut & Connell, 2007; Manuel *et al*., 2010; Keiser & Garner, 2012:84) shows that consumers have preferences on how apparel should fit them at the different body parts. Findings of the current study informs the South African industry of RTW apparel fit preferences of consumers of different body shapes, an understanding of which places manufacturers in a better position to know which apparel styles to produce. Almost all the predominant African and Caucasian body shapes showed a preference for closely fitted apparel at all the selected body parts, except the Caucasian rectangle, which preferred semi-fitted apparel at the abdomen. While previous research also conducted abroad (Anderson *et al*., 2001; Li *et al*., 2003; Alexander *et al*., 2005; Chattaraman & Rudd, 2006; Manuel *et al*., 2010; Song & Ashdown, 2012) shows a relationship between fit preference and body shape, body cathexis, and fit problems, this study showed that the young African and Caucasian women preferred closely fitted apparel despite their different body shapes, their experiencing fit problems at those body parts and whether they were dissatisfied with the body part or not. This confirms the results of Nkambule's (2010) study who found that modern plus-size working Swazi women prefer close-fitting clothes that follow their body lines, irrespective of their body size. Nkambule (2010) also found that younger women's preference for a close fit was significantly higher than mature women's preference. This information points to other factors that influence individuals' fit preference which were beyond the scope of this study and may need to be further explored.

Contrary to what was found in previous research abroad, (Anderson *et al*., 2001; Li *et al*., 2003; Alexander *et al*., 2005; Chattaraman & Rudd, 2006; Manuel *et al.*, 2010; Song & Ashdown, 2012), which suggested that apparel manufacturers and retailers should determine their consumers' fit preferences as it is subjective and cannot be deduced from the consumers' fit problems, body shapes and cathexis, this study confirms that fit preference depends on, among other things, one's personal preference, attitude, desired look, current fashion trends, cultural influences, age, sex, body shape and lifestyle (Brown & Rice, 2001:261; Rudd & Lennon, 2000; Keiser & Garner, 2003:31; Alexander *et al*., 2005; Song & Ashdown, 2012). It is such that when these factors change, one's personal fit preferences may change too. Therefore, every apparel manufacturer must determine the fit preferences and factors influencing fit preferences of their target markets from time to time to produce apparel that suits their target markets' fit expectations. After identifying consumers' fit preferences, RTW apparel manufacturers can produce better suited styles at the critical fit points. This study provides data on fit preferences of young African and Caucasian body shapes. As informed by the findings of this study, the RTW apparel industry should be cognisant of the fact that young African and Caucasian women sampled in this study preferred close fit at all the selected body parts. This could form a starting point for further research on fit preferences of the ethnically diverse South African female consumer population.

6.5 GENERAL RECOMMENDATIONS

Due to the non-probability sampling techniques employed and the smaller sample size of young members of the South African female apparel consumers from two ethnic groups used in this study, the findings and conclusion drawn from this study cannot be generalised to the entire female South African population. However, the following recommendations are made to the ready-to-wear apparel manufacturers and retailers in South Africa.

The present study identified the triangle, hourglass and rectangle shapes as predominant shapes among the sampled young African and Caucasian consumers. Body shape characteristics as well as body measurements of the predominant African and Caucasian body shapes from the sampled participants were significantly different from those of the Caucasian hourglass that is used as a standard figure in the apparel industry. It is therefore recommended that RTW apparel manufacturers must reconsider their use of the Western/Caucasian hourglass as a design base, and should consider using the body shapes prevalent within their target populations. Therefore, from the findings of this study it is recommended that the South African apparel manufacturers and retailers and all other stakeholders should consolidate efforts with other institutions such as Woolworths and Ergonomics Technologies that have already taken the initiative towards a national consumer surveys of body measurements of female South African apparel consumers of different ethnic and age groups. These must be captured using reliable methods. Furthermore, they have to identify and classify the body shapes prevalent among the different ethnic and age groups from which size charts and sizing systems that are representative of the population's body measurements and body shapes can be developed. The South African RTW apparel manufacturers and retailers need to acknowledge the different body shapes prevalent among the ethnically diverse South African population.

To ensure improved RTW apparel fit for ethnically diverse consumers, fit models and body forms used in fit quality management should be representative of the body shapes prevalent within the population. Apparel retailers and marketers may also consider advertising their apparel products using models with body shapes that represent their target markets, so that apparel consumers may relate to their apparel, which may reduce fit concerns. Strydom and de Klerk (2006) observed that the RTW apparel sold in South Africa does not specify the body measurements and body shapes of consumers it is meant to fit, which is one of the contributory factors to fit problems. This study therefore recommends that size labels should contain the body measurements and body shapes of the target market it is produced to fit. The industry should also regulate apparel sizing by, among other things, controlling the standard figures used by the different manufacturers. Retailers should also be informed of these developments so that they may assist consumers in selecting appropriate RTW apparel. Consumers too, should be knowledgeable about their key measurements as well as their body shapes if they are to benefit from the above recommendations.

While it was expected that body shape influences one's body cathexis, fit preferences and consequently apparel fit problems, this study also found that almost all the African and Caucasian body shapes reported being dissatisfied with their middle and lower body parts. On the other hand, all the predominant African and Caucasian body shapes preferred closely fitted apparel on all the selected body parts, even those they were dissatisfied with, as well as those on which they reported apparel fit problems. It is therefore recommended that apparel manufacturers need to investigate the apparel fit preferences and body cathexis and body shapes of their target market. This may help RTW apparel manufacturers to better understand the interrelationship between body shape, fit problems, body cathexis, fit preferences as well as the relationship between fit problems and cathexis of their target population. The challenge would be to convince the South African clothing industry to change their attitudes towards results and recommendations of scientific research. Although in the short term, it may be difficult to make drastic changes, the apparel industry should not ignore findings of such studies.

6.6 LIMITATIONS OF THE STUDY AND RECOMMENDATION FOR FURTHER RESEARCH

The sample used in this study was obtained through non-probability sampling (purposive and snowballing), therefore the findings of this study may not be generalised to the entire South African population of women. This was a descriptive exploratory study, with the focus on African and Caucasian women aged between18 and 25, which excluded other age groups as well as other ethnic groups. A nationwide study would give a better understanding of body shape prevalence among all the South African ethnic groups of different age groups. Such a study would give exhaustive comparative data of the whole female consumer population in South Africa.

The present study used 3-D body scanning. A limitation emanating from the use of this technology included the fact that the 3-D body scanner was availed to the researcher (for data collection) only for a limited period of time to collect data only from subjects who were available during this period, thus limiting the sample size. Another nationwide study could be undertaken where the 3-D body scanner could be moved to the different provinces in South Africa for an extended period of time so that more data could be collected, using probability sampling techniques, which could result in generalised conclusions that would be applicable to the whole South African female population. The scanner was housed at the Consumer Science Department of the University of Pretoria, and as a result the sampled participants (n = 234) were only those who were within the vicinity of the University of Pretoria and therefore excluded subjects who met the characteristics of the target population but could not be reached due to distance.

The data analysis in this study required a comparison of several categories of each variable across the six predominant body shapes, which resulted in the distribution of data over many cells in the tables, resulting in fewer expected frequencies in a number of cells. Consequently, sparse data did not allow statistical tests, e.g. the Chi-square test to determine the association between variables. It is recommended that a study with a large sample size be conducted to allow the investigation of associations between for instance: the perceived ideal figure and body shapes, body part cathexis and body shapes, perceived RTW apparel fit problems and body shapes, perceived RTW apparel fit problems and body part cathexis, RTW apparel fit preferences and body shapes, ready-to-wear apparel fit preferences and body part cathexis, and RTW apparel fit preferences and perceived RTW apparel fit problems of predominant body shapes.

This study was focusing only on significant differences in body measurements, disregarding some of the Mean differences that were not statistically different. Though these Mean differences were not significantly different, they may have fit implications and may therefore need to be taken into consideration during pattern designing. Another study could therefore look into how Mean differences (no matter how small) of key body measurements impact on apparel pattern grading and sizing.

This research relied on self-reported fit problems only, which as indicated earlier may be subjective and fit may have been influenced by other factors. Therefore another study could consider other objective ways of testing fit to conclusively report on participants' fit problems.

Furthermore, the use of the 3-D body scanner was limited to capturing virtual images and extraction of body measurements, yet it could also be used for body shape classification and to evaluate other aspects such as apparel fit.

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ADDENDUM 1: CONSENT LETTER

University of Pretoria

CONSENT FOR PARTICIPATION IN A RESEARCH PROJECT
DEPARTMENT OF CONSUMER SCIENCE

PROJECT TITLE: BODY SHAPE CHARACTERISTICS, BODY CATHEXIS, APPAREL FIT PREFERENCES AND PROBLEMS OF YOUNG AFRICAN AND CAUCASIAN WOMEN

Dear Participant,

I am Bukisile Makhanya a PhD student at the University of Pretoria, Consumer Science Department. I am currently conducting a research that seeks to compare body shape characteristics, body cathexis, apparel fit preferences and perceived fit problems of African (Black) and Caucasian (White) South African women aged between 18 and 25.

You are kindly requested to participate freely and voluntarily in study by honestly completing a questionnaire and undergoing three-dimensional body scanning to capture your body profile and measurements. You are assured that information gathered in this exercise will be kept confidential and anonymous and will be used only for academic purposes. Be advised that you are at liberty to withdraw from this exercise if and when you deem it necessary.

Kindly sign below consenting to voluntary participate in this study. Any concerns, questions and comments regarding this study may be directed to Prof. H.M de Klerk email: Helena.deklerk@up.ac.za phone: 012 420 2531

__________________________ __________________________

Participant Date

Researcher: Bukisile Makhanya
Email: bukisile.Makhanya@up.ac.za
Cell: 0724607713

ADDENDUM 2: QUESTIONNAIRE

For Office Use Only

Respondent's code

A QUESTIONNAIRE TO INVESTIGATE BODY CATHEXIS, FIT PREFERENCES AND PERCEIVED READY-TO-WEAR APPAREL FIT PROBLEMS OF YOUNG SOUTH AFRICAN WOMEN.

INSTRUCTIONS: **Answer all questions.** Choose **only one** option by putting an **"X"** over the number assigned to the selected answer.

SECTION A: CONSUMER PROFILE

1. What is your ethnic group?

African/Black	Caucasian/White
1	2

V1

2. To be measured after scanning.

2.1

Body Height (in cm)

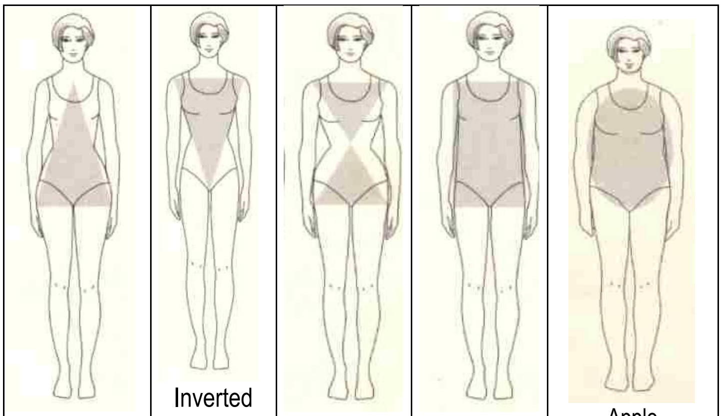
V2.1

2.2

Body Weight (in kg)

V2.2

3. In your own **opinion**, which of the figure types shown below do you consider **an ideal figure**? Please mark **"X"** in the box under the figure. Choose **only one** option**.**



Triangular	Inverted triangular	Hourglass	Rectangular	Apple
1	2	3	4	5

V3

SECTION B: CONSUMERS' SATISFACTION WITH THEIR BODIES

4. Please indicate by marking **"X"** to indicate your **level of satisfaction** with the specified part of the body. Choose **only one** option for each body part**.**

	BODY PARTS	Extremely satisfied	Satisfied	Slightly satisfied	Neither	Slightly dissatisfied	Dissatisfied	Extremely dissatisfied		
	Upper Body	-	-	-	-	-	-	-		
4.1	Neck	7	6	5	4	3	2	1	V4.1	
4.2	Shoulders	7	6	5	4	3	2	1	V4.2	
4.3	Upper Back	7	6	5	4	3	2	1	V4.3	
4.4	Lower Back	7	6	5	4	3	2	1	V4.4	
4.5	Back height (nape to waist)	7	6	5	4	3	2	1	V4.5	
4.6	Front height (neck to waist)	7	6	5	4	3	2	1	V4.6	
4.7	Bust	7	6	5	4	3	2	1	V4.7	
4.8	Stomach/Midriff	7	6	5	4	3	2	1	V4.8	
4.9	Waist	7	6	5	4	3	2	1	V4.9	
	Lower Body	-	-	-	-	-	-	-		
4.10	Abdomen	7	6	5	4	3	2	1	V4.10	
4.11	Hips	7	6	5	4	3	2	1	V4.11	
4.12	Buttocks	7	6	5	4	3	2	1	V4.12	
4.13	Crotch line	7	6	5	4	3	2	1	V4.13	
4.14	Thighs	7	6	5	4	3	2	1	V4.14	
	Whole Body	-	-	-	-	-	-	-		
4.15	Body build	7	6	5	4	3	2	1	V4.15	
4.16	Body profile	7	6	5	4	3	2	1	V4.16	
4.17	Body posture	7	6	5	4	3	2	1	V4.17	
4.18	Body weight	7	6	5	4	3	2	1	V4.18	
4.19	Body height	7	6	5	4	3	2	1	V4.19	
4.20	General body appearance	7	6	5	4	3	2	1	V4.20	

SECTION C: PERCEIVED READY-TO-WEAR APPAREL FIT PROBLEMS

5. Please indicate by marking **"X"** to indicate **how often** you experience ready-to-wear apparel **fit problems** on the specified part of the body? Choose **only one** option for each body part.

	BODY PARTS	Never	Seldom	Sometimes	Often	Always		
	Upper Body	-	-	-	-	-		
5.1	Neck	1	2	3	4	5	V5.1	
5.2	Shoulder	1	2	3	4	5	V5.2	
5.3	Upper Back	1	2	3	4	5	V5.3	
5.4	Lower Back	1	2	3	4	5	V5.4	
5.5	Back height (nape to waist)	1	2	3	4	5	V5.5	
5.6	Front height (neck to waist)	1	2	3	4	5	V5.6	
5.7	Bust	1	2	3	4	5	V5.7	
5.8	Stomach/Midriff	1	2	3	4	5	V5.8	
5.9	Waist line	1	2	3	4	5	V5.9	
	Lower Body	-	-	-	-	-		
5.10	Abdomen	1	2	3	4	5	V5.10	
5.11	Hipline	1	2	3	4	5	V5.11	
5.12	Buttocks	1	2	3	4	5	V5.12	
5.13	Crotch line	1	2	3	4	5	V5.13	
5.14	Thighs	1	2	3	4	5	V5.14	

6. Please indicate by marking **"X"** to indicate the **ready-to-wear apparel fit problem** you experience on the specified body part? Choose **only one** option for each body part.

	BODYPART	Too tight/ too short	Too loose/ too long	No fit problem		
	Upper Body	-	-	-		
6.1	Neck	1	2	3	V6.1	
6.2	Shoulder	1	2	3	V6.2	
6.3	Upper Back	1	2	3	V6.3	
6.4	Lower Back	1	2	3	V6.4	
6.5	Back height (nape to waist)	1	2	3	V6.5	
6.6	Front height (neck to waist)	1	2	3	V6.6	
6.7	Bust	1	2	3	V6.7	
6.8	Stomach/Midriff	1	2	3	V6.8	
6.9	Waist	1	2	3	V6.9	
	Lower Body	-	-	-		
6.10	Abdomen	1	2	3	V6.10	
6.11	Hips	1	2	3	V6.11	
6.12	Buttocks	1	2	3	V6.12	
6.13	Crotch line	1	2	3	V6.13	
6.14	Thighs	1	2	3	V6.14	

SECTION C - *Continued*: PERCEIVED READY-TO-WEAR APPAREL FIT PREFERENCES.

7. Please mark **"X"** under the **kind of fit you prefer** at the following parts of the body. Choose **only one** fit option for each body part.

	BODY PARTS	Closely fitted	Fitted	Semi-fitted	Loosely fitted	Very loosely fitted		
	Upper Body							
7.1	Neck	1	2	3	4	5	V7.1	
7.2	Shoulders	1	2	3	4	5	V7.2	
7.3	Upper Back	1	2	3	4	5	V7.3	
7.4	Lower Back	1	2	3	4	5	V7.4	
7.5	Back height (nape to waist)	1	2	3	4	5	V7.5	
7.6	Front height (neck to waist)	1	2	3	4	5	V7.6	
7.7	Bust	1	2	3	4	5	V7.7	
7.8	Stomach/Midriff	1	2	3	4	5	V7.8	
7.9	Waist	1	2	3	4	5	V7.9	
	Lower Body	-	-	-	-	-		
7.10	Abdomen	1	2	3	4	5	V7.10	
7.11	Hips	1	2	3	4	5	V7.11	
7.12	Buttocks	1	2	3	4	5	V7.12	
7.13	Crotch line area	1	2	3	4	5	V7.13	
7.14	Thighs	1	2	3	4	5	V7.14	

ADDENDUM 3: BODY SHAPE ASSESMENT SCALE

For Office Use Only

Scan Image Code

[ ]

Panelist Code

[ ]

A1 [ ]

A2 [ ]

BODY SHAPE ASSESMENT SCALE

1. (a) The body appears to fit into which body build category? (Please **mark "X" one**)

	X
Slender	**1**
Average	**2**
Large	**3**

A3 [ ]

(b) The **overall body posture** appears----------------- (Please **mark "X" one**)

	X
Sway back	**1**
Erect	**2**
Stooped	**3**

A3 [ ]

PART-TO-PART EVALUATION

2. Study the following **Front** and **Side** (profile) views of each of the whole body scan images and mark with an **"X"** the statement that best describes the **part-to-part** proportions of the body shape.

(a) **Shoulders** appear --- (Please **mark "X" one**)

	X
Narrower than the hips	**1**
Same width as the hips	**2**
Wider than the hips	**3**

A5 [ ]

(b) **Bust shape/ size** appears --- (Please **mark "X" one**)

	X
Flat and smaller than hips	**1**
Average/ medium same as the hips	**2**
Prominent /fuller and wider than hips	**3**

A6 [ ]

(c) **Waist** appears -- (Please **mark "X" one**)

	X
Narrower than the hips	1
Same width as the hips	2
Wider than the hips	3

A7 ☐

(d) **Bust** position appears --- (Please **mark "X" one**)

	X
Lower than normal	1
Normal	2
Higher than normal	3

A8 ☐

(e) **Upper body** appears --- (Please **mark "X" one**)

	X
Shorter than lower body	1
Same length as lower body	2
Longer than lower body	3

A9 ☐

PART-TO-WHOLE BODY EVALUATION

3. Study the following **Front** and **Side** (profile) views of each of the whole body scan images and mark with an **"X"** the statement that best describes the **part-to-whole** proportions of the body shape.

(a) **Shoulders** appears -- (Please **mark "X" one**)

	X
Squared	1
Ideal/ Normal	2
Sloping	3

A10 ☐

(b) **Stomach and abdomen** appear -- (Please **mark "X" one**)

	X
No fullness looks flat	1
Fullness (" b") below waist	2
Fullness ("D") extending from the bust to the crotch	3
Fullness "B" extending from bust to the crotch	4

A11 ☐

(c) **Seat/ buttocks** appear --- (Please **mark "X" one**)

	X
Flat with very small fullness if any	1
Average protrusion with moderate rounded shape	2
Full protrusion extending **("d")** large fullness extension	3

A12 ☐

(d) **Upper back** appears -- (Please **mark "X" one**)

	X
Flat / straight upper back	1
Moderately rounded upper back	2
Fully rounded upper back	3

A13

(e) **Lower waist back curvature** appears -- (Please **mark "X" one**)

	X
Flat back waist / non hollow	1
Moderately hollow back waist	2
Deep hollow back waist	3

A14

(f) **Hip shape** appears --- (Please **mark "X" one**)

	X
Flat or straight	1
Moderately rounded	2
Fully rounded	3

A15

(g) **Bust/Cup size** appears-- (Please **mark "X" one**)

		X
Small	Cup A	1
Small	Cup B	2
Medium	Cup C	2
Large	Cup D	3

A16

(h) **Broadest hip position** appears --- (Please **mark "X" one**)

	X
At low hip level	1
At normal/ middle hip level	2
At higher hip level	3

A17

(i) **Thigh bulge** appears --- (Please **mark "X" one**)

	X
Small bulge (flat) no thigh bulge or same as hips	1
Average bulge (large bulge extending slightly beyond the hip)	2
Large bulge extends excessively beyond the hip	3

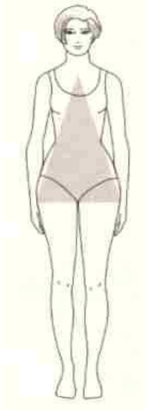
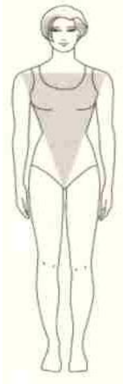
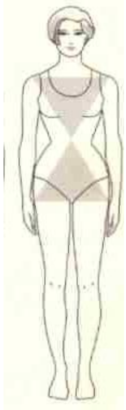
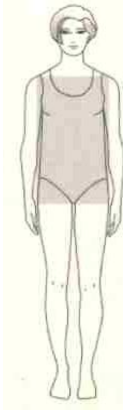
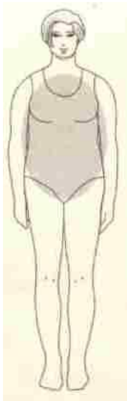
A18

(j) **Legs** appear -- (Please **mark "X" one**)

	X
Shorter than torso	1
Same length as torso	2
Longer than torso	3

A19

4. Please assign a figure shape that holistically describes the critical features of each body in terms of bust, waist and hips (please **mark one**).

 Triangular	 Inverted triangular	 Hourglass	 Rectangular	 Apple
1	**2**	**3**	**4**	**5**

A20 [ ]