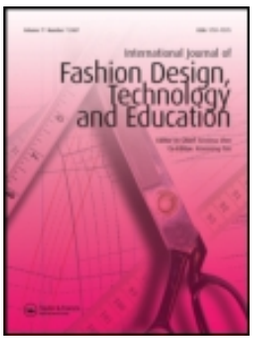

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Identification of a unique African female body shape

Ann Mastamet-Mason[a], Helena M. De Klerk[b]* and Susan Ashdown[c]

[a]*Department of Fashion Technology, Tshwane University of Technology, Pretoria, South Africa;* [b]*Department of Consumer Science, University of Pretoria, Pretoria, South Africa;* [c]*Department of Human Ecology, Cornell University, Ithaca, NY, USA*

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The use of body scanning technology in sizing and fit research in developing countries is in many cases not practical considering its cost and technologies involved. The purpose of this study was to identify and describe the distinctive body shapes of Kenyan women without the use of body scanners. The units of analysis were urban women between the ages of 25 and 55 from Kenya. Due to a lack of a body scanner, traditional anthropometrical techniques for obtaining body dimensions and digital photography were used as an alternative method. A trained panel and the IGRAFX Designer 5 software were used for the visual analysis of the photos. The rectangular body shape was the most distinct body shape emerging from both the dimensions and evaluations of the photographs, with the triangle body shape as the second most distinct shape, but there are distinct differences between the Kenyan and American rectangular body shapes.

Keywords: body shape; sizing and fit; body dimensions

1. Introduction

The problem of fit with ready-made apparel has recently gained a lot of attention as the demand for better fitting apparel increases (Ashdown 1998, Shin and Istook 2007). Unfortunately, similar to the case in many developed countries, apparel-fit problems continue to plague many consumers, retailers and manufacturers in most developing countries. Kenya's ready-made apparel manufacturers fall into two major categories, namely those that manufacture on a large scale, usually referred to as the industry manufacturers (formal sector) and those that manufacture in mass, but in smaller quantities, comprising tailors, dressmakers and home sewers (informal sector) (Ongile and McCormick 1996, Mason 1998). The few remaining large-scale manufacturers can further be split into those producing for the local market and those that produce purely for export (Ongile and McCormick 1996).

In Kenya, the sources of size databases are unknown and/or outdated, as the available anthropometric data were collected in 1975 (Kenya Bureau of Standards, KEBS 2001 – Appendix 4A). This information is ambiguous since the original source of the anthropometric data mentioned is unknown. The size standards do not give any breakdown of body shapes or population representations of different sizes. However, body dimension charts need to be revised frequently to keep abreast with continuous biological changes that occur in individuals and generations (Winks 1997, Le Pechoux and Ghosh 2002, Olds 2003, Bye *et al*. 2006). It is assumed that the size charts used in Kenya's apparel industries are borrowed or copied from foreign established charts. It has been observed that existing size charts used by most manufacturers were copied or adapted in the hope that they would also work for their target market (Winks 1997, Zwane and Magagula 2006). However, since people's shapes and sizes vary, adapted sizing systems would result in ill-fitting apparel items.

Apparel production, trade and consumption are currently undergoing dramatic upheavals in Kenya. Domestic production of ready-made apparel for local consumption has declined tremendously as the industry operates in an environment characterised by competition from imports of new and second-hand apparel as well as counterfeit textile products (Mason 1998, Regional Agricultural Trade Expansion Support (RATES) Program 2003). Significant changes in the global regulatory environment affecting Kenya, including preferential trade agreements with the European Union (the Cotonou Convention of 2000) and the United States (the African Growth and Opportunity Act, passed by the United States Congress in 2000), have resulted in tremendous growth in emerging export apparel production just prior to the upcoming end of the Multi-Fibre Agreement in 2005 (Omolo 2006). The increasing importation of second-hand

*Corresponding author. Email: helena.deklerk@up.ac.za

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apparel, banned in Kenya until the 1990s, has likewise profoundly affected production of, trade in and consumption of apparel (McCormick *et al.* 2001, KEPZA 2005). Nevertheless, the textile industry ranks first among Kenya's manufacturing sectors in terms of both size and employment (GOK 2000, RATES 2003). Existing apparel manufacturers produce various types of apparel items, both for the local market and for export. Local apparel manufacturers supply only 45% of the Kenyan textile market requirements, while imported new and second-hand apparel accounts for about 37% of the market. The demand for textile products in the country is estimated to be growing at 3.8% annually (Ministry of Trade and Industry in KEPZA 2005).

With the worldwide continuous increase in international trade in apparel, Kenya – like many other countries – has also witnessed enormous growth in ready-to-wear women's apparel retailing. Many apparel retail stores operating throughout the major cities and towns of the country bear witness to this. Although locally produced ready-made apparel in Kenya accounts for 45% of all ready-made apparel supplied to the local market, this figure is likely to decline as most consumers become more exposed and critical to the way an apparel item fits. The sound traditional custom-made apparel as well as the imported new and second-hand ready-made apparel are an indication that Kenyan consumers' consumption pattern would soon lean more towards apparel items that are likely to satisfy their needs (Ongile and McCormick 1996, Mason 1998).

A review of the literature indicates that problems related to apparel fit stem from a variety of factors, such as an outdated anthropometric database from which sizing systems are developed, a lack of classified body shapes, non-standardised communication of sizing and fit and non-standardised fit quality management amongst the apparel industries (Salusso-Deonier 1989, Chun-Yoon and Jasper 1996, Winks 1997, Ashdown 2000, Desmarteau 2000). Fit is defined as the relationship between the apparel's dimensions and the three-dimensional human size and form/shape (Kadolph 1998, Keiser and Garner 2003, Solomon and Rabolt 2004). In other words, it is the apparel item's silhouette and size being right for the human's body shape and dimensions. Fit issues would therefore be seen as those measures carried out by the apparel industry to achieve well-fitting apparel for the target market's body shapes and sizes. However, female body shapes and proportions vary and change over time and between populations. These differences have an impact on the fit of the constructed apparel, be it ready-made or custom-made (Winks 1997, Ashdown 1998, Simmons and Istook 2003). Given that ready-made apparel depends on an accurate estimate of the distribution of body shapes and sizes within a target population, it becomes necessary for every country, and even regions within countries, to establish their own sizing systems based on the target population (Ashdown 2000, Devarajan and Istook, 2004, Simmons *et al.* 2004a, Honey and Olds 2007, Lee *et al.* 2007).

Living in a consumer-driven era (Capraro *et al.* 2003), companies should aim at managing consumer satisfaction/dissatisfaction by producing products that are tailored to the consumers' fit preferences. The challenge to the apparel industries is not about giving customers extra choices, but rather to contain consumers' individual preferences. Considering that the majority of female consumers are dissatisfied with the fit of female ready-made apparel (Klepp and Storm-Mathisen 2005, Otieno *et al.* 2005), most studies carried out were done in developed countries (Kurt Salmon Associates 1996, Otieno *et al.* 2005, Zwane and Magagula 2006, Shin and Istook 2007) while little has been done in a developing country such as Kenya. In an attempt to solve the sizing and fit problems associated with body size and shape, apparel industries and academics in developed countries have introduced body scanners and automated manufacturing systems. These have facilitated easy and faster mass-customised apparel, with fewer sizing and fit problems. The use of body scanning technology is, however, relatively new and its use in developing countries is in many cases not practical considering its cost and other technologies involved. This, however, should not discourage scholars, who could still employ other techniques for the identification of cultural unique body shapes in developing countries. The purpose of this study was therefore to identify and describe the distinctive body shapes of Kenyan women without the use of body scanners and to determine the difference between these body shapes and the Western distinctive body shapes.

2. Review of the literature

A sizing system comprises the assignment of body dimensions and a group of body shapes representing a market segment. A sizing system that sets out to satisfy its target market must be up to date, precise in measurements and body shape classification (proportions) and must represent the population that it is designed for (Schofield *et al.* 2006).

Ready-to-wear apparel depends on an accurate estimate of the distribution of body shape and sizes within a target population (Yu in Fan *et al.* 2004). The adequacy of a standard sizing system depends on both database and body shape classification methods

(Ashdown *et al*. 2004). An anthropometric database must be classified such that the majority of the sample is accommodated by a minimum number of size categories, yet it should integrate the variation in body shapes within the population that the sizing system is expected to serve (Workman 1991, Ashdown 1998, Loker *et al*. 2005).

Body classification based on a target market ensures that consumers within that market would be able to purchase apparel with a better fit (Chun-Yoon and Jasper 1996, Loker *et al*. 2005). Most developed countries have classified women's shapes to ease the apparel selection crisis experienced within retail environments and to provide better-fitting apparel. Body shapes in the past have been classified into the prevalent five figure types (hourglass, triangle, rectangular, apple and inverted triangle) by drop values. A drop value is the difference between the hip circumference and the bust circumference or the difference between the bust and the waist (Chun-Yoon and Jasper 1996, Winks 1997, Beazley 1998, Gupta and Gangadhar 2004, Yu 2004:185). Simmons *et al*. (2004a, 2004b) applied the female figure identification technique (FFIT) and used six dimensions (bust, waist, hips, high hip, abdomen and stomach) to classify American women into nine different body shapes, namely hourglass, bottom hourglass, top hourglass, spoon, rectangle, diamond, oval, triangle and inverted triangle. Further research was conducted to validate the FFIT methodology (Devarajan and Istook 2004). With the FFIT software Lee *et al*. (2007) identified seven different body shapes amongst Korean women, namely hourglass, spoon, bottom hourglass, top hourglass, inverted triangle and rectangle. Unfortunately, developing countries such as Kenya have no classification of body shapes. It is assumed that the apparel designs in Kenya are based on Western established body shapes, and hence all the fit problems with the ready-made apparel available.

3. Methodology

3.1. Sampling

The units of analysis for this study were female urban high-school teachers between the ages of 25 and 55 from three major cities (Nairobi, Kisumu and Eldoret) situated in the central and western regions of Kenya. They were used to represent urban career women in Kenya. A systematic sampling technique was chosen because probability sampling avoids the researcher's biases in element selection. As an entry strategy, the researcher and the research assistant were forced to develop strong trust and rapport with the participants by providing their own photographs that were taken while dressed in body suits and without any masks on their faces. The purpose and importance of the study were comprehensively explained to all the willing participants. Out of the 301 participants identified for the original study sample as initially pre-determined by the researcher and the statistician, 123 participants agreed that their body dimensions may be taken and 89 participants' photographs were taken.

3.2. Data collecting techniques

For the purpose of identifying the distinct body shapes of the career women in Kenya, and due to the lack of a body scanner, traditional anthropometrical techniques of obtaining body dimensions were employed in this study. To enhance reliability in taking body dimensions, the researcher was trained in anthropometry as a level one Kinanthropometrist offered by the International Society for the Advancement of Kinanthropometry (ISAK). A pre-tested improvised anthropometer and specified measuring instruments used in apparel anthropometric studies (such as calibrating metal measuring tapes, setsquare and segometer) were used for taking the measurements (Figure 1). The procedure used for land marking followed standardised methods stipulated by ISAK (2001) and Simmons and Istook (2003). Measurements were taken according to the standards of ISO (1989), ASTM (1999), ISAK (2001) and Simmons and Istook (2003).

Based on the study of somatography (Gazzuolo *et al*. 1992, Kuma 1999) and the concept of imagery with the body-scan technologies, it was decided to use photography for this study as an alternative method to body-scan technologies. Female participants were photographed with a digital camera using standardised methods while dressed in minimal apparel (body suits/leotards) and assuming different positions/views (front, back and side/profile). In order to achieve consistency and reliability when photographing, all sets of photographs were taken from the same distance, with subjects and the photographer taking the same postures and positions. Six-meter guiding grid paper was mounted on the wall and extended to the forefront on the floor. The extended section on the floor had two sets of footprints marked on it. The first set was close to the wall and indicated the subject's position, while the second set was further away from the wall and indicated the photographer's position. The grid paper was divided up into 15 cm squares with a bold line down the centre, which served as a balancing point when photographing. The background (grid paper) was to standardise all the photos taken and to allow ease of judgement concerning each shape later in the analysis. All the sets of photographs were taken from

the same position and distance, while the subjects took specific standardised poses and were dressed in similar styled and neutral-coloured (gray) body suits/leotards, in order to ensure uniformity and clarity during the evaluation later (Gazzuolo *et al.* 1992, Kuma 1999, Anderson *et al.* 2001). Photographs were taken from the front, side and back. Subjects were requested and assisted regularly to stand erect and directly on the footprints, with the head in the Frankfort plane position and with the grid central line passing through their mid-points (Figure 2).

3.3. Data analysis

The captured data were compared with every completed body measurement form to ensure that the information of each measurement form was correctly captured. Statistics used were descriptive methods that integrated simple percentiles to univariate and bivariate combinations. These analyses were employed for the purpose of dividing the study population into subgroups. The data were normalised, giving ranges of two standard deviations on either side of the mean

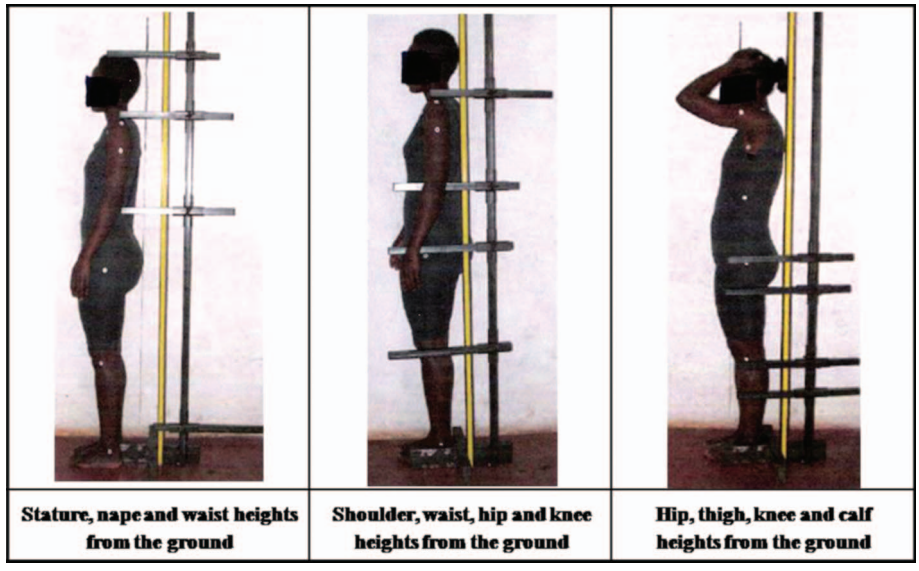

Figure 1. Height measurements using standing anthropometer.

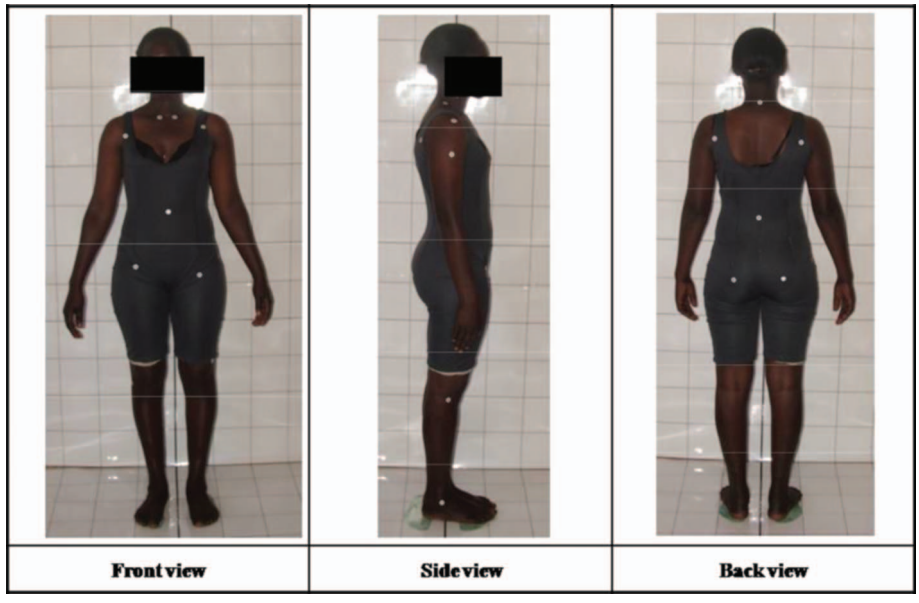

Figure 2. Different views of body shapes.

value, which covered 95% of the population where applicable. This removed the extreme dimensions in a range, which could cause distortion. The mean values ± the standard deviations (SD) facilitated the classification of height groups (short, medium and tall), and the body shape categories of distinct characteristics (small, medium and large).

A literature search was done to identify descriptive parameters to define the five prevalent shapes (hourglass, triangle, inverted triangle, apple and rectangular), for the purpose of setting up standards within the maximum and minimum dimensions of the drop values. The drop values used were the difference between the bust and the hip dimensions and the difference between the bust and waist dimensions. Since the five main body shapes only served as a guide for the purpose of identifying the body shapes in this study, it was not possible to classify body shapes using the concept of 'Mean ± SD', because the rule allows classification into only three categories (small, medium and large). However, Shin and Istook (2007) report that the waist measurement for the rectangular shape is nine inches (23 cm) less than the bust. Rasband and Liechty (2006) state that the waist of an hourglass body shape measures more than 10 inches (25 cm) less than the hip or the bust. Using the range (maximum and minimum) dimensions of the drop values within the context of the anthropometric data of this study, in combination with the recommendations of Shin and Istook (2007) and Rasband and Liechty (2006), it was possible to identify the different body shapes of this study (refer to Table 1 for shape parameters).

To process the data in a logical and direct meaningful manner, the first printouts were converted from a random order to a grouped height order, as body height has been reported as one of the control dimensions for most apparel (Winks 1997, Gupta and Gangadhar 2004). The data were then re-arranged into the different body shapes within the range of drop values. The drop values of the bust and the hips facilitated the identification of triangle and inverted triangle body shapes, while the remaining body shapes (rectangle, hourglass and the apple) were identified by the drop values of bust and waist dimensions (the difference between the bust and the waist dimensions). Hip-bust drop values were used to establish the sizes of the hips and bust in relation to each other for the purpose of sorting out the inverted triangle shapes and the triangle shapes respectively. Drop values or key dimensions are considered to be the best predictors of all the other body dimensions and have been widely used for body shape classifications (Le Pechoux and Ghosh 2002, Gupta and Gangadhar 2004).

There is no known research that has been carried out on Kenya's female body shapes. Therefore, this being a virgin study on female body shapes, the researcher subjected all the photographs to a thorough scrutiny by examining and studying each body shape's components from the front, back and – more critically – the side view. Using the Western established body shapes as point of departure and as a launching ground for this study (Rasband and Liechty 2006), the researcher was able to identify a distinct (rectangular)

Table 1. Shape parameters and percentage distribution of body shapes ($n = 123$).

Body shape categories				
Triangular and inverted triangle body shape categories **1st step**: Triangle and inverted triangle depend on bust and hip relationship and are opposite to each other. Once these two body shapes were sorted out, they were not subjected further to waist and bust relationship.				
Univariate analysis of drop values	**Mean**	**SD**	**Maximum**	**Minimum**
Hip minus the bust	5.6 cm	8.8 cm	26.0 cm	−8.0 cm
Mean (5.6) + SD (8.8) = ≥14.0 cm to ≤26.0 cm (Max*)	Triangle (large hips)		24 (21.5%)	
Mean (5.6) − SD (8.8) = −8.0 cm (Min*) to >3.2 cm	Inverted triangle (large bust)		2 (1.5%)	
Apple, rectangular and hourglass body shape categories **2nd step:** Apple, rectangular and hourglass shape rely on bust and waist relationship. Rectangular = waist 23.0 cm less than the bust (Shin and Istook 2007). Hourglass = waist 25 cm less than the bust (Rasband and Liechty 2006). Categories were guided by the standards within the range values.				
Univariate analysis of bust minus the waist drop values	6.0 cm	13.0 cm	36.0 cm	−13.0 cm
Standards within the maximum and minimum dimensions of the drop values	**Body shape**		**Count (%)**	
−13.0 cm (Min*) to ≤4.7 cm	Apple (large waist)		2 (1.5%)	
>23.0 cm to 36.0 cm (Max*)	Hourglass (narrow waist)		2 (1.5%)	
>4.7 cm to ≤23.0 cm	Rectangular/Straight (Average waist)		93 (74%)	

Notes: *Min = Minimum range value; Max = Maximum range value.

body shape appearing to contain a long torso and strong features – and to take note of those characteristics that differ from the Western established body shapes. The body shapes provided were compiled, based on descriptions as well as illustrations found in Salusso-Deonier (1989), Rasband (1994), Armstrong (1995), Fiore and Kimle (1997), Kuma (1999), Connell *et al*. (2003), Devarajan and Istook (2004), Simmons *et al*. (2004a) and Rasband and Liechty (2006).

Body characteristics that were uncommon for the Western established rectangular shape were the thigh bulge that seemed to be situated at approximately two inches (5 cm) below the normal hipline (trochanterion position), the strong (rounded) upper shoulder blades and strong buttocks, contributing to a deep hollowed back waist. The stomachs appeared like a strong block extending from just below the bust to below the waistline, down to the crotch line region at the front (Figure 3).

From the raw photographs, it was almost impossible to extract all the details as exhaustively as possible. The researcher, with the help of Microsoft Photo Editor, was able to get the photographs edged, as shown in Figure 4. This permitted a clear outline of the body for more additional scrutiny. From the negatives and the edged shapes, pronounced details such as a stomach shape from just below the waistline (appearing as the letter 'b'), to another shape with more weight concentrated below the waistline (and appearing more like the letter 'D') and to shapes where

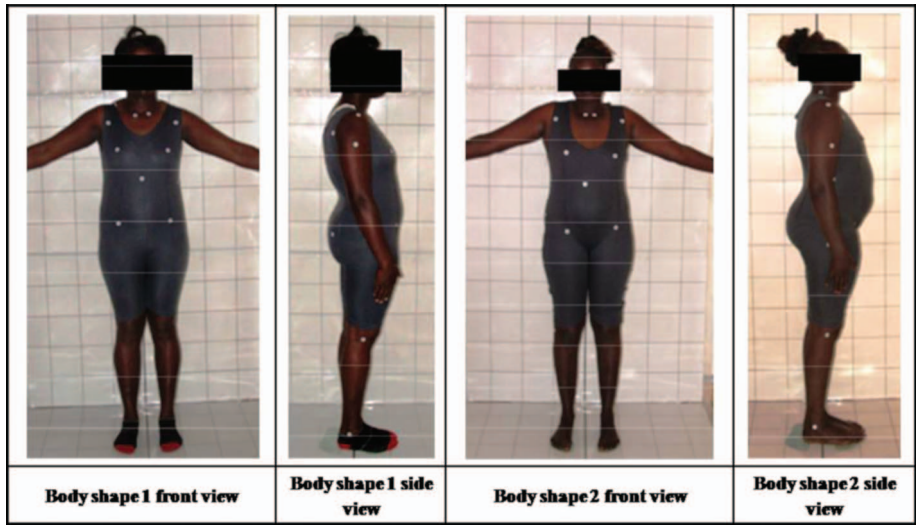

Figure 3. Unrefined photos.

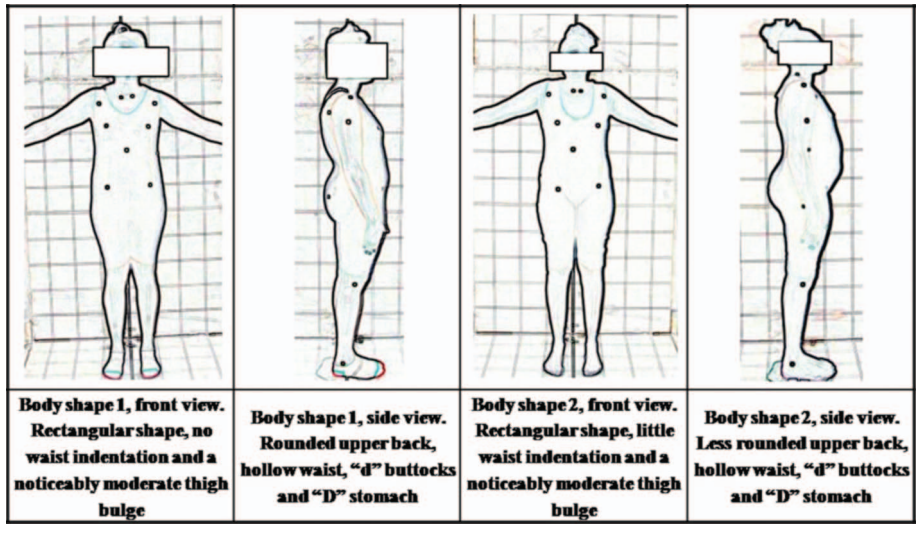

Figure 4. Edged photographs.

the weight extended from above and below the waistline to the crotch at the centre front. The back shape became clearly outlined, ranging from a less-hollow waist to a sharp deep hollow at the back waist (lordosis), depending on how rounded the upper shoulder blades and the depth of the buttocks were (appearing like the letter 'd' when they conspicuously protrude beyond the rest of the body).

The IGRAFX Designer 5 software was used to extract only the important characteristics that were identified in the first and the second steps above. This decision was reached for the purpose of developing preliminary subgroups with similar characteristics. Each individual picture was copied into Adobe Photoshop CS. The resolution was increased to 762 pixels per square inch and the pictures were saved as *.bmp (bitmap) files so as to improve the quality and to make them manageable while being manipulated when drawing and extracting specific characteristics. With the use of IGRAFX Designer 5 software, the software scale was set to 1 cm = 5 cm, and 1 cm × 1 cm grid-lines were drawn over the blank page. This page was saved as a template. The pictures were then imported individually onto the blank template in IGRAFX Designer 5 and saved as *.dsf (designer) files. The picture size was then reduced and the pictures were manipulated by means of rotation so that the grid-lines on the template and the grid-lines on the pictures matched perfectly.

With the use of the dimension tool in IGRAFX Designer 5 software, the measurements between specific points that were predetermined by the researcher were drawn in. White lines were used in drawing and marking specific points because the background was dark, and thus a lighter colour was used for visibility reasons. All the markings and drawings made were scaled as shown in Figure 5, to assist in the proportional comparisons and assessments to be made later. The picture was then manipulated by means of rotation back to its original position. The picture and all the measurements were selected and then re-exported and saved as a *.jpg (jpeg) file. The compound line tool in IGRAFX Designer 5 software was used to make the silhouette outline. The picture with the measurements was used and the silhouette drawn over it. The silhouette was then extracted to an open space on a blank page template as shown in Figure 5. This was then exported and saved as a *.jpg (jpeg) file. These steps were carried out on all the pictures' views of back, front and side. Once all the pictures were completed, the *.jpg (jpeg) files were then re-inserted into Microsoft Word 2003 for accessibility and presentation in a versatile format.

From Photoshop, it was easy to evaluate each shape (photo) and assign it to one of the five prevalent body shape categories (rectangle, hourglass, triangle, apple and inverted triangle). The researcher prepared a comprehensive training manual and a body shape assessment scoring sheet/scale to enhance trustworthiness and reliability of this study (evaluations of the photographs). It was reasoned that accuracy in evaluations could be achieved if there were some form of agreement between different evaluators and if they worked according to a uniform method of assessment. In this study, two professionals in the field of apparel design and manufacture were believed to be experts and qualified enough for the assessment of the body shapes. Their professional experience ranged from 14 to 25 years of field experience, respectively. However, as both evaluators were experts in apparel design and manufacture, which involves an understanding of the human figure and translating it into

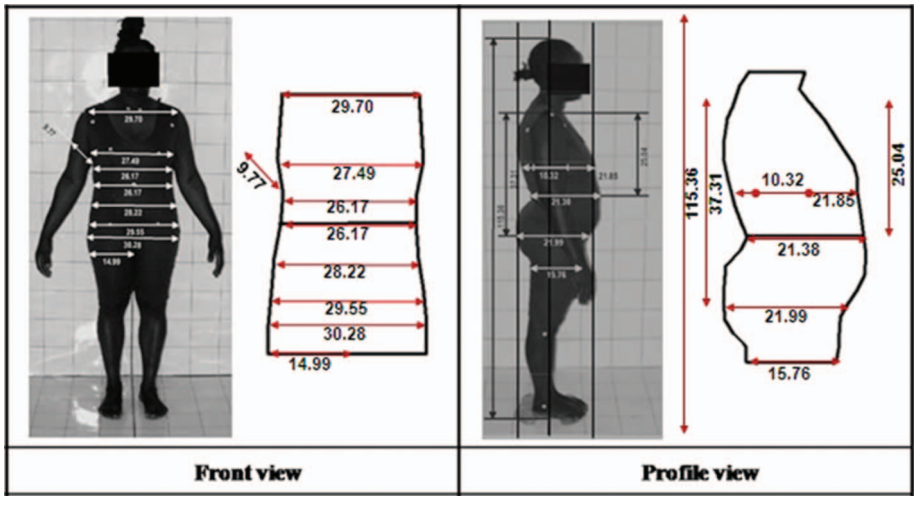

Figure 5. Silhouettes extracted by IGRAFX Designer 5 software.

apparel, each evaluator independently studied the training manual and practised with similar stimulus material (sample photos).

With the use of the evaluation guiding principles highlighted in the training manual and the assessment scale, the two trained professional experts evaluated all 89 sets of photos within 7–14 days. The data were analysed and inter-rater reliability tests were performed using Kappa statistics, to estimate the degree of consistent agreement between the two raters. After inter-rater reliability tests and data analysis had been done, it was observed that the degree of consistent agreement between the evaluators had Kappa values that ranged from 0.2 to 0.9. Landis and Koch (1977) suggest that Kappa values of 0.00 reflect poor agreement, 0.01–0.20 slight agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement, 0.61–0.80 substantial agreement and 0.81–1.00 almost perfect agreement. In this study, it was decided to use a Kappa value of 0.75 as the cut-off point for acceptable agreement. This implied that all the evaluations with Kappa values of >0.75 were accepted, while evaluated attributes with <0.75 agreement were rejected on condition that they were to be further subjected to a professional group of experts' evaluations for a final decision. The group of experts comprised three professionals who are experts in apparel design-related careers. Their respective professional experience in the field of apparel design ranged from 10–20 years, which ensured the reliability of their judgements.

4. Results and discussion

4.1. Demographics

Respondents fell into three age groups, namely the young adult group (25–32 years) (33%), the middle group (33–40 years) (43%) and the mature group (41 + years) (24%). Thirty percent of the respondents considered the fit of local ready-made apparel as good, while 44% considered it as fair and 26% as poor. Thirty seven percent reported their own body shape as hourglass, 24% as triangle, 16% as apple, 14% as rectangle and 9% as inverted triangle.

4.2. Results from measurements

From the measurements taken, Table 1 clearly portrays that the rectangular body shape was the most (74%) prevalent body shape in the sample, followed by the triangle body shape (21.5%). The other body shapes (apple, hourglass and inverted triangle) had the least representation of 1.5% each. Since most ready-made apparel is manufactured based on the hourglass body shape proportions, Kenya's career women are therefore likely to experience fit problems with ready-made apparel (again refer to table 1 for shape parameters and body shapes).

Other characteristics that prevailed with the distinct body shapes (rectangular and triangle) were (Table 2) the large buttocks (69%), large thigh bulge (83%) and large bust as indicated by the bust extension (79.6%). The body shape was also characterised by a larger front arc at the bust and waistline regions, whereas the back arc dimension was large at the hip region. The body shape's height proportions showed that waistline, hipline and knees were higher than the normal, ideal figure's height positions, whereas the bust line was situated below the normal height position.

4.3. Results from photographs

From the analysis of the photographs it was clear (Table 3) that the majority (70%) of participants appeared to have a rectangular body shape, while participants who appeared to have a pear/triangle body shape were 13%. The rest of the body shapes were hardly represented.

Figure 6 indicates that the rectangular body shape was the most distinct body shape emerging from both the dimensions (74%) and the evaluations of the photographs (70%). The second most distinct body shape emerging from both the dimensions (21.5%) and the evaluations of the photographs (13%) was the triangle body shape – although the percentage representation differs. The rest of the body shapes were least represented.

Considering that body dimensions are one-dimensional elements, it would not be possible to isolate contours and precisely locate the positions of body characteristics, such as buttocks and bust contours along circumferential dimensions. Images taken from different angles, however, facilitated comprehensive scrutiny on the size/depth of any contours and any outlines that appear on the body. It was therefore possible to segregate body characteristics with the use of two body shape identification techniques, namely using body dimensions and evaluations of photographs.

Using both methods of body shape identification, the study therefore demonstrated that the prevalent body shape that emerged from the body dimensions and evaluation of the photographs was the rectangular body shape, which is typified by medium height, large buttocks, large thighs and large stomachs appearing like the letter 'D'. It is further characterised by a rounded upper back and a hollow back waist (lordosis curve) – making the shape appear imbalanced from the side view (Figure 7). However, more of the mature females appeared larger, with protruding stomachs ('D'), and a moderately rounded upper back. The

Table 2. Percentage distributions of height, bust extension, buttock extension and thigh bulge categories ($n = 123$).

Height				
Univariate analysis of height dimensions	**Mean**	**SD**	**Maximum**	**Minimum**
	161.6 cm	5.6 cm	176.0 cm	148.0 cm
Height categories	**Mean ± SD**		**Count (%)**	
Short	148.8 cm to <156.0		12 (10%)	
Medium	≥156.0 cm to ≤167.6 cm		93 (75%)	
Tall	>167.6 cm to 176.0 cm (Max*)		18 (15%)	
Bust extension				
Univariate analysis of bust extension	**Mean**	**SD**	**Maximum**	**Minimum**
	16.0 cm	3.0 cm	23.0 cm	10.0 cm
Bust extension categories	**Mean ± SD**		**Count (%)**	
Small/flat	10.0 cm (Min*) to <13 cm		1 (0.8%)	
Medium	≥13.0 cm to ≤19.0 cm)		24 (19.6%)	
Large	>19.0 cm to ≤23.0 cm (Max*)		98 (79.6%)	
Buttock extension				
Univariate analysis of buttock extension	**Mean**	**SD**	**Maximum**	**Minimum**
	16.0 cm	3.0 cm	23.0 cm	9.0 cm
Buttock extension categories	**Mean ± SD**		**Count (%)**	
Small/flat	9.0 cm (Min*) to <13 cm		3 (2%)	
Medium	≥13.0 cm to ≤19.0 cm		36 (29%)	
Large	>19.0 cm to ≤23.0 cm (Max*)		84 (69%)	
Thigh bulge				
Univariate analysis of thigh bulge	**Mean**	**SD**	**Maximum**	**Minimum**
	2.5 cm	2.0 cm	6.0 cm	0.0 cm
Thigh bulge categories	**Mean ± SD**		**Count (%)**	
Small thigh bulge	<1.0 cm		1 (0.8%)	
Medium thigh bulge	≥1.0 cm to ≤5.0 cm		20 (16.2%)	
Large thigh bulge	>5.0 cm to ≤6.0 cm (Max*)		102 (83%)	

Notes: *Min = Minimum range value; Max = Maximum range value.

Table 3. Percentage distributions of body shape categories ($n = 89$).

Body shape categories	Frequency	Percentage (%)
Rectangular/straight	62	70
Pear/triangle	12	13
Hourglass	8	9
Barrel/inverted triangle	3	3.5
Apple	4	4.5

majority of the younger females appeared smaller, with fully rounded upper backs and half of them had 'D'-shaped stomachs, while the other half had 'b'-shaped stomachs.

The results from both the body dimensions and the evaluations of the photographs further demonstrated that both techniques when combined yield even better results which can address apparel fit problems more closely. However, it is almost impossible to identify all the body shape characteristics using one method only. Considering that body scan technology is not popular in developing countries due to its cost and the technology involved (Xu *et al.* 2002), it may be reasoned that in the meantime, both the body shape identification techniques (from the dimensions as well as visual evaluations of photographs) could be used simultaneously to produce reasonably reliable results.

5. Conclusions and implications

It can be concluded that, although the rectangular body shape is the strikingly distinctive body shape found in both America and Kenya, there are distinct differences between the Kenyan and American rectangular body shapes. The Western rectangular body shape, according to Rasband and Liechty (2006), has a strong ribcage and upper hip tapering a little towards the waist, or sometimes not tapering at all. The shoulder width appears similar to the hip measurement, with very little waist indentation. Waist circumference measures less than 9 inches (23 cm) than the

hip or bust circumference (Shin and Istook 2007), the bust is small and there is no thigh bulge. The side view characteristics mentioned are the large stomach and a more flat back curvature, right from the upper back to the buttocks appears like the apple body shape's profile. Rasband and Liechty report that once a rectangular shape attains more weight, it results in an apple shape (Rasband and Liechty 2006).

In this study (Figure 8), the emerging Kenyan rectangular front view shape is characterised by a shoulder width that is similar to the width of the hips, and a small waist indentation of less than 9 inches (23 cm). The thighs on the side bulge out beyond the hip width and are full at the inside (crotch), in contrast to the Western body shape. A rounded upper back characterises the profile view, with more roundness

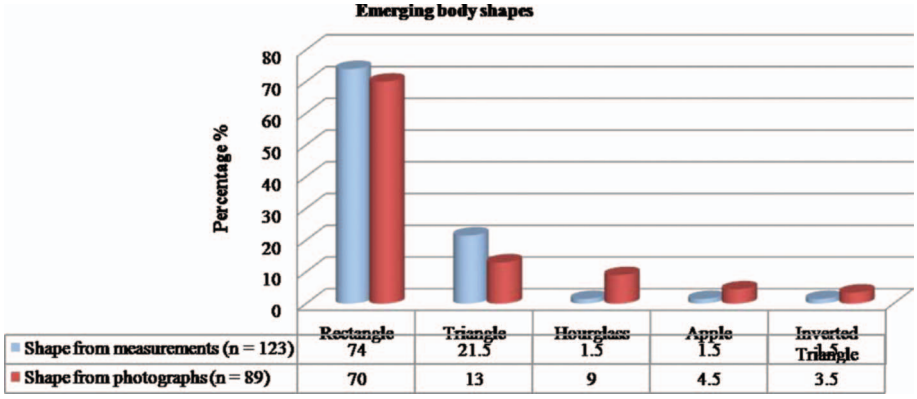

Figure 6. Emerging body shapes from the dimensions and evaluations.

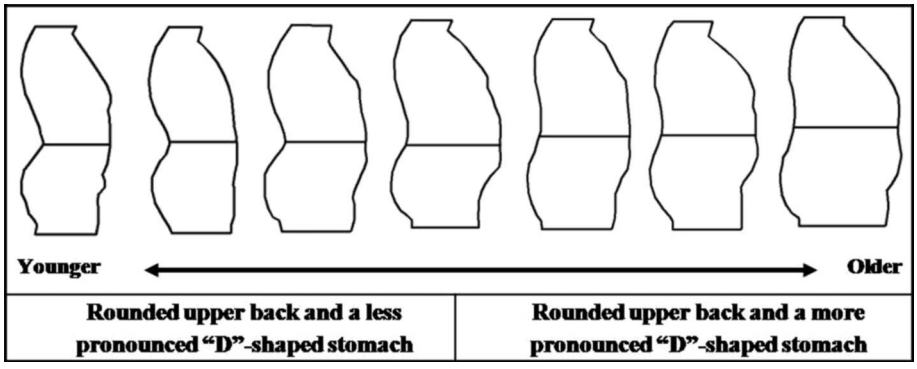

Figure 7. Profile view characteristics among different age groups.

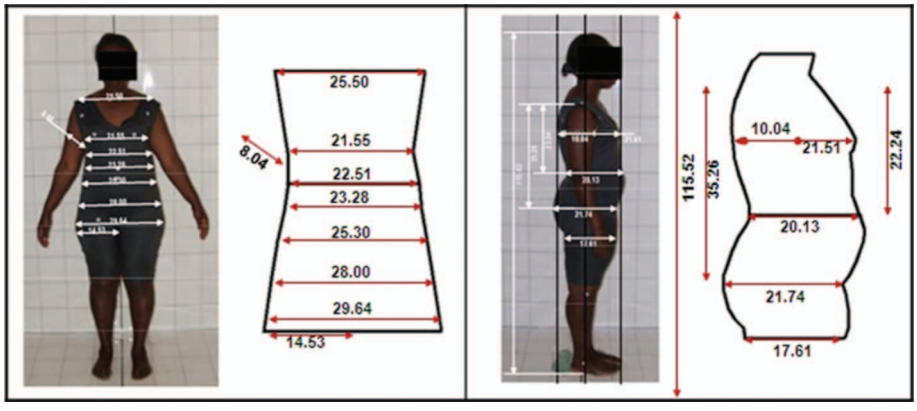

Figure 8. Curvy rectangular body shape.

concentrated just below the shoulder line and the chest. The back curvature tapers narrowly towards the waistline and abruptly meets the full buttock contour, resulting in a deep hollow waist region (lordosis curve). The front side of the profile view is characterised by a high abdominal contour that begins to protrude just below the bust line. It begins to curve round almost instantly, and increases as it leads down to the crotch at the centre of the body, resulting in a 'D' appearance. A brief description of this kind of body shape would be a curvy, rectangular female body shape.

It can further be concluded that, considering that ready-made apparel items are designed based on the ideal (hourglass) body shape (Loker *et al*. 2005, Zwane and Magagula 2006, Shin and Istook 2007), career women in Kenya with the rectangular body shape are likely to be dissatisfied with the fit of ready-made apparel. This is because their body shapes differ not only from the Western ideal shape, but also from the Western rectangular shape.

Having looked at the critical fit points and scrutinised the fit implications associated with the curvy rectangular shape, it has become clear that it would be unrealistic for apparel industries to continue manufacturing styles that are suitable for the hourglass body shape (fit model), and expect to fit the curvy rectangular shape appropriately. The quality of apparel in respect of its fit can only be determined collectively, through dress forms, fit models and sizing systems, which all have to represent the target population's sizes and body shapes (Salusso-Deonier 1989, Ashdown *et al*. 2004, Bougourd 2007).

Apparel designers must distinguish how the Kenyan career women's curvy rectangular shape differs from the Western rectangular body shape, and furthermore, how it deviates from the so-called ideal (hourglass) body shape. Understanding the underlying differences in body shape could help designers to translate the distinct body characteristics of the curvy rectangular shape into better-fitting apparel items for the Kenyan career women. Fit models as well as dress forms chosen for fit testing and modelling in the apparel industry should reflect the characteristics of the prevalent curvy rectangular shape. It could also be recommended that apparel manufacturers adjust their current sizing systems to cater for the Kenyan career women's distinctive curvy rectangular body shape, rather than continuing with the production of inappropriate apparel meant for the ideal (hourglass) shape. Although this was a study in Kenya, it may be reasoned that most developing African nations lack a classification of their body shapes and therefore experience challenges with apparel fit. As many developing countries, specifically African developing countries, have largely been neglected with regard to apparel fit, emerging countries with people of diverse cultures, such as South Africa also needs to follow the example set out in this study.

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