

Sizing and fit research at grassroots level A methodology for the identification of unique body shapes in African developing countries

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OPSOMMING

Inleiding en literatuur agtergrond

Vanuit die literatuur en vorige navorsing is dit duidelik dat vroulike verbruikers van menige Westerse lande vandag probleme ondervind met die passing van koop-klaar-klere. Ontwikkelende lande in Afrika, soos byvoorbeeld Kenia, ondervind dieselfde probleme. Ongelukkig beskik hierdie lande nie oor die nuutste tegnologie, vaardighede en finansiële ondersteuning ten einde navorsing te kan uitvoer wat gerig is op die oplos van grootte-en-pas-probleme binne die kledingindustrie nie. Menslike liggaamsvorms en proporsies verander mettertyd en verskil ook van kultuurgroep tot kultuurgroep, van land tot land en selfs van streek tot streek binne 'n spesifieke land. Daar kan dus nie maar aangeneem word dat klere wat verbruikers van een land pas, verbruikers van 'n ander land of kultuurgroep gaan pas nie. Ten einde die probleem van grootte-en-pas te kan oplos, is dit dus belangrik dat daar van tyd tot tyd in alle lande antropometriese opnames gemaak word ten einde 'n beeld te kry met betrekking tot die groottes, proporsies en liggaamsvorms van die inwoners van die land. Sulke navorsing is nog nie voorheen in Kenia uitgevoer nie. Die vraag waarom dit dus in hierdie navorsing gegaan het is: Hoe lyk die Keniaanse vroulike verbruiker se unieke liggaamsvorm/s en hoe dra dit by tot die probleme wat die vroulike verbruiker in Kenia tans ondervind met die passing van klere?

In menige ontwikkelde Westerse en Oosterse lande word grootte-en-pas-navorsing vandag met die hulp van sogenaamde liggaamskandeerders ("body scanners") gedoen. Liggaamskandeerders is weens 'n gebrek aan finansies en tegniese vaardighede nie in Kenia beskikbaar nie, en gevolglik moes die navorsers hul wend tot alternatiewe tegnieke vir die bepaling van liggaamsvorm. Twee tegnieke, wat ook voorheen op beperkte skaal gebruik is vir die bepaling van liggaamsvorm, is vir die doel van hierdie studie aangepas, naamlik die bepaling van liggaamsvorm deur middel van die gebruik van liggaamsmates, en deur visuele ontleding deur 'n opgeleide paneel sensoriese evalueerders. Hierdie artikel rapporteer dus oor die veldwerk-metodologie wat vir die doel van die navorsing ontwikkel en suksesvol toegepas is.

Metodologie

Die artikel rapporteer die metodologie wat beplan

is, probleme wat in die veld ondervind is, asook hoe die probleme opgelos is ten einde geloofwaardige data te kon genereer en die doelwitte van die navorsing te kon bereik.

Steekproef Die studie was beperk tot twee geografiese gebiede in Kenia, naamlik die Westelike gebied (Eldoret en Kisumu) en die Hoogland gebied (Nairobi). Die eenheid van analise was hoërskool onderwyseresse wat in stedelike gebiede woonagtig is en in die ouderdomsgroep 25 jaar tot 55 jaar val. 'n Sistematiese ewekansige steekproef tegniek is gebruik en 301 onderwyseresse is identifiseer.

Soos wat dikwels die geval is met veldwerknavorsing het die navorsers menige probleme op grondvlak ondervind en moes menige strategieë in werking gestel word ten einde deelnemers wat aanvanklik identifiseer is en gewillig was om deel te neem, te oortred om wel aan die navorsing deel te neem. Dit was uiteindelik moontlik om die liggaamsmates van 123 deelnemers te neem, terwyl 89 deelnemers gewillig was dat daar foto's van hulle in minimale kleredrag geneem kon word. Die steekproef was egter groot genoeg om statisties betroubare resultate te kon genereer.

Metodes Ten einde in staat te kon wees om wel die navorsing deur te voer, was dit nodig om liggaamsmates van deelnemers te neem, asook om hulle in minimale drag te fotografeer, wat dan die navorsers in staat sou stel om die unieke liggaamsvorm/s van die Keniaanse vroulike verbruiker te identifiseer. Die neem van liggaamsmates het, onder meer, impliseer dat die navorsers kreatief moes dink met betrekking tot die nodige apparaat wat vir so 'n oefening nodig is. 'n Aangepaste antropometer is onder meer ontwikkel, terwyl dit ook nodig was dat die navorsers onderrig moes word in die neem van antropometriese mates.

Die neem van voor-, sy-, en agteraansig digitale foto's het onder meer impliseer dat spesiale passende lyfkouse vir die neem van die foto's konstrueer moes word, dat 'n ateljee opgerig moes word en dat 'n paneel opgelei moes word om die visuele evaluering te kon doen.

Data analise Beskrywende statistiek is gebruik vir die analise van die mates terwyl 'n opgeleide paneel kledingkundiges die visuele evaluering van die foto's gedoen het.

Evaluering, gevolgtrekkings en aanbevelings

Ten spyte van probleme tydens die veldwerk, waarvan die kry van gewillige deelnemers waarskynlik die grootste was, kon die navorsing suksesvol deurgevoer word en betroubare data kon gegenereer word om die doelwitte te bereik. Die navorsers het tot die gevolgtrekking gekom dat die twee tegnieke gesamentlik sinvol gebruik kan word om liggaamsvorm te bepaal. Die gebruik van die twee tegnieke behoort 'n uitdaging te wees vir die toegewyde en kreatiewe navorsers wat bereid is om grootte-en-pas navorsing sonder die hulp van moderne tegnologie deur te voer.

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INTRODUCTION AND LITERATURE BACKGROUND

Female body shapes and proportions vary and change over time, as the result of, amongst others, nutritional changes, lifestyles and ethnicity. These differences have an impact on the fit of the constructed apparel, be it ready-made or custom-made (Hillestad, 1980; Winks, 1997:20; Ashdown, 1998; Simmons & 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; Simmons & Istook, 2003; Simmons *et al*, 2004).

The problem of fit with ready-made apparel has gained a lot of attention as consumer demand for well-fitted apparel increases. Dissatisfaction with fit is one of the most frequently stated problems with garment purchases. Women have been reported as the most dissatisfied consumers (DeLong *et al*, 1993; Alexander *et al*, 2005; Otieno *et al*, 2005). This has resulted in the emergence of mass-customisation establishments, which have been facilitated by the use of body scanners in the developed countries. Through body-scan technology, body dimensions and shapes are easily and rapidly extracted from a population and converted immediately into body shape categories, size charts and patterns for garment production (Ashdown, 1998; Simmons & Istook, 2003; Ulrich *et al*, 2003; Ashdown *et al*, 2004; Fiore *et al*, 2004).

Although a considerable body of sizing and fit research has already been done, most of the research has been done in first-world countries. This is understandable because the "modern-world-consumer" wants and demands well-fitting clothes and the clothing industries can benefit by supplying well-fitting clothes that suit the body shapes of the consumer they are catering for. However, in many cases these "well-fitting" clothes are manufactured in third-world countries that, in turn, are dumped with clothes, made to fit a totally different (and in most cases Western) body shape, from which the specific country's consumer then has to make a decent choice. African developing countries such as Kenya also face apparel-fit problems.

Dimensions from the human body are the underpinning to an effective sizing system and consequently better-fitting apparel items. Sizing systems originate from people's measurements and body shapes (Bye *et al*, 2006; Petrova, 2007:56). Since the body shape is three-dimensional, the measurements obtained from it must be accurately taken and representative of the body's characteristics that are critical to apparel's fit. This would facilitate the production of apparel items, which harmonises with the body shape. The measurements and the varied body shapes can only be accurate, consistent and representative if they are taken accurately by correct methods, instruments and techniques employed (Ashdown, 2000; Simmons &

Istook, 2003; Ashdown & Dune, 2006). Up-dated and current population measurements are therefore vital in most countries, to minimize fitting problems related to ready-made apparel (Kunik, 1984:12; Winks, 1997:14; Ashdown *et al*, 2004; Simmons *et al*, 2004). The question for this research was thus: What are the distinctive women's body shapes in Kenya and how does it contribute to the fit problems that female Kenyan consumers experience?

Ashdown (2000) sees sizing systems as the focus around which all factors concerning sizing and fit evolve. She has identified the main factors affecting sizing systems and consequently the fit of ready-made apparel to be the population measures (body measurements), the design features (construction of the apparel), the fit issues (fit-quality management) and the communication of sizing and fit (size labelling). Body shape/form, being a framework for clothing (Salusso-Deonier, 2005), will affect all these components in one way or another. For example:

- ◆ Body measurements require measuring the body in a specific way that will facilitate body-shape classification and accurate reflection of the three-dimensional body's characteristics when the garment is made.
- ◆ The design features require that the body's framework (three-dimensional characteristics) be correctly interpreted to provide the patterns for the construction of well-fitting clothes.
- ◆ The fit issues (fit-quality management) require that the fit-test techniques used, such as the use of fit models and dress forms, are in agreement with body shapes of the target market.
- ◆ Communication of sizing and fit requires that measurements and body shapes indicated on size labels reflect the true picture of the target market.

Most female sizing systems, currently in use, are based on the ideal Western figure that has well-proportioned body components. Although shapes have been classified in most developed countries to solve the problem of apparel's fit, African shapes, with reference to Kenya, have however not been considered.

It is clear from the research that few previous researchers have involved themselves in research concerning the classification of body shapes, probably due to the fact that this type of research happened to be very time- and energy-consuming – a fact that should change with the emergence of body scanners. Except for body-scanning technology, two techniques were previously used (although on limited scale) for the classification of body shape, namely the use of body dimensions for body-shape classification, and body-shape classification through the analysis of visual stimuli by trained sensory evaluators.

Body dimensions (measurements) are defined as those dimensions obtained from an individual to be used in pattern design for garment construction or used to create a set of clothing for a variety of people in the target market (Ashdown, 2000). Measurements can only be accurate and representative if they are

taken accurately by correct methods, instruments and techniques employed (Ashdown, 2000; Simmons & Istook, 2003). There are three common methods of obtaining body measurements namely, (1) traditional tailor's measurements (termed as unreliable because there are no standardized procedures of taking the measurements), (2) anthropometry, which is a standardized, valid and reliable procedure involving defined body parts to be measured as well as the use of specified instruments and standardized measuring methods acquired through training (Ashdown *et al*, 2004; Simmons & Istook, 2003), and (3) three dimensional body scanning, which is a more accurate modern non-contact method that captures the outside surface of the human body within a few seconds (Ashdown, 2002; Simmons & Istook, 2003). Use of body scanning technology is relatively new and its use in developing countries is not practical considering its cost and other technicalities involved. For the purposes of this study, traditional anthropometry was the only option for obtaining measurements for the purposes of body-shape identification.

Sensory evaluation is the assessment of a product using sensitivity of human senses. It implies the evaluation of selected characteristics of a product under controlled conditions by a trained panel of judges (American Society for Testing and Materials [ASTM], 1999:3; Leibowitz & Post, 1982:4; Lyon *et al*, 2000:1). Photography may be defined as the art of capturing images using either an ordinary or a digital camera. It may be argued that in describing body shapes, measurements alone would not be enough to give a true representation of the proportions of a body. It is therefore essential to study relative proportions through visual images as well as the actual measurements. Salusso-Deonier *et al* (1991) used photographs of various body shapes in their research about observers' perceptions of male and female body types. Kuma (1999:39) trained an expert panel on the use of photographs for the clarification of female body shapes. Connell *et al* (2003:73) trained a team of experts in female body shape analysis and used the visual images of body scans as stimuli for the identification of body shapes. Body shape analysis by using body measurements and by using the visual analysis of body shapes by a trained panel, seemed to be the way to go for the identification of body shapes of Kenyan women.

This article therefore focuses on a methodology that proved to be of value and could in future be applied in research within the field of the sizing and fit of clothes in developing countries where the need for well-fitting clothes exists, but where a lack of necessary technological and financial support also exists. The aim of this article is to report on a fieldwork methodology that was tested, proved to generate trustworthy results, and could be used by future researchers who would like to involve themselves in sizing and fit research in developing countries.

METHODOLOGY

Sampling

The study was limited to two urban geographical regions in Kenya, namely, the Western region (Eldoret and Kisumu) and the Upland region (Nairobi). The unit of analysis was urban high school female teachers within the two regions. They fell within the 25 and 55 age bracket, as teaching profession in Kenya begins at age 25 while retirement age is attained at 55. Being professional teachers, it was assumed that they were exposed to fashion, have the income to spend on clothing and are also critical to apparel's fit. It was also advantageous, as they would be studied easily at their places of work.

A systematic sampling technique was chosen for this study, because probability sampling avoids the researcher's conscious or unconscious biases in element selection (Kerlinger, 1986:110-111; Bailey, 1994:90; Babbie & Mouton, 2001:201-202; Strydom & Venter, 2002:205). There are 41 urban government and private schools in the Western region of Kenya with a total population of 1083 female teachers. Twelve schools (six each from Eldoret and Kisumu) with a total population of 150 female teachers were systematically selected. There are 35 urban government and private schools with a total population of 1052 female teachers in Upland (Nairobi) region. Twelve schools with a total population of 151 were systematically selected from this region.

The list of names was obtained from respective schools. The first number was determined through flipping a coin (head-odd number and the tail-even number). In the Western (Kisumu) region the 9th number was randomly selected as a starting number. There after, every 3rd school was picked from the list. A total of 76 female teachers were expected to participate in the study. In the Western (Eldoret) region, the 5th number was randomly picked as a starting number. There after, every 3rd school was picked from the list. A total of 74 female teachers were to participate in the study. In the Upland (Nairobi) region, the 15th number was randomly selected as a starting number (point). There after, every 3rd school was picked from the list. A total of 151 female teachers from this region were selected to participate in the study.

Methods

For the purpose of identifying a distinct body shape of women in Kenya, traditional anthropometrical techniques of attaining body dimensions were employed in this study. Anthropometry has been applied in many studies, while photography (somatography - the visual evaluation of body photographs and subsequent categorizing them into different body builds) has scantily been used, but has however produced reliable results (Salusso-Deonier *et al*, 1991; Kuma, 1999:39; Anderson *et al*, 2001:7; Douty, 1963 cited in Connell *et al*, 2003). It may be argued that in describing body shapes, measurements alone would not be exhaustive enough to give true representations of the proportions of the body. Profile characteristics such as, pelvic tilts (buttock prominence), stomach protrusions, back cur-

vature and breast protrusions can only be understood through visual analysis of the body's silhouette and profile. Based on this reasoning, as well as a review of the literature of traditional anthropometry, somatography and body shape classifications, a comprehensive body measurement data-capturing sheet, body shape assessment training manual and body shape assessment scale were compiled.

Preparations for measuring and photographing exercises

The body measurement data-capturing sheet contained upper and lower parts of the body's dimensions that were carefully selected to enrich the quality of body shapes' sorting and identification. The body measurement data-capturing sheet was designed to facilitate measuring. Height and vertical measurements were grouped and arranged in the order of their sequences from the top to lower part of the body. All the horizontal (girth) measurements and all the width and length measurements were also grouped and arranged from the right to the left part of the body in order of their occurrences.

Prior to taking measurements as well as photos, the subjects were informed about the apparel items to be used, the measurements to be taken and the different views required for the images. To be efficient and effective in the exercise, the subjects were provided with and requested to wear body suits (leotards) with minimal thickness that follow the natural contours of the body without binding as recommended by the International Society for the Advancement of Kinanthropometry (ISAK) (2001). This was to ensure uniformity amongst all the participants. Due to lack of ready-made leotards in the recommended colour and style, the researcher made 20 body suits that were used by all the participants. They were dry cleaned after each use. Size description system used for assigning sizes to the body suits was the lettered type of small (S), medium (M), large (L) and extra large (XL). The measurements used for the production of the body suits were based on the Kenya size standards (Kenya Bureau of Standards [KEBS], 2001). The Small (S) size category comprised sizes 8 and 10 measurements, the medium (M) size category comprised sizes 12 and 14 body dimensions, large (L) category comprised of size 16 and 18 body dimensions, while extra large (XL) comprised sizes 20 and 22 measurements.

Measuring instrumentation and techniques

Apparel anthropometry studies specifically use apparatus that have been developed to produce reliable and valid measurements. An anthropometer (measuring stand), consisting basically of a graduated rule in millimetres, vertically mounted and with a moveable arm is used for measuring straight linear distances, while callipers are used to measure linear depths and widths. Calibrated measuring tapes are used to measure circumferences (Beazley, 1997; Ashdown, 2000).

According to Babbie and Mouton (2001:74) the nature of the research problem statement and the resources available determine to a certain extent the data-collection methods to be used in a study. For the purposes of this study and due to available resources the

researcher consulted professional anthropometrists from the company ERGOnomics TEChnology (ERGOTECH) in South Africa for training on how to take body dimensions professionally and the suitable instruments to be used. ERGOTECH manages the database of the South African Defence Force and therefore has experience in conducting anthropometric surveys. In this regard, ERGOTECH's measuring techniques and instruments that are used were considered reliable and valid. To enhance reliability further in taking body dimensions, the researcher took a one-week's training course in anthropometry as a level 1 Kinanthropometrist offered by ISAK. This course included theoretical work and practical assignments and was presented by the only internationally recognised anthropometrist in South Africa. Based on long-term expertise and experience of ERGOTECH, the researchers' training with ISAK and a thorough review of literature, the decision to use specific instruments (Figure 1) for this study was reached. ISO (1989), ASTM (1999), Beazley's (1996) and Simmons and Istook's (2003) techniques of taking body dimensions, were also consulted for the decision taken.

Due to limited funds available and the unavailability of an anthropometer, the researcher opted to use an improvised standing anthropometer, with approximate resemblance of the real anthropometer. It consists of a measuring stand, basically of a graduated rule in centimetres and millimetres. It contains two parallel metal bars held at right angles from the base and braches (blades) mounted at right angles on the fittings that slide/move along one of the vertical primary rods as shown in Figure 1. It was designed according to specified measurements referred from an ordinary anthropometer. After it was assembled, it was subjected to critical testing for accuracy and reliability. The improvised standing anthropometer was used for measuring all the straight vertical linear distances as shown in Figure 2. A stature meter was used interchangeably with the anthropometer for the height

measurements. All the contour measurements were measured using a 200 cm long dressmaker's metal and glass fibre tape interchangeably to avoid stretching and tear during the exercise. A setsquare was used for locating trunk line on the side, while a segometer (an instrument that measures lengths and widths) was also used interchangeably with metal or fibreglass tape to measure widths (Figure 1). All these instruments were used after consultation with an anthropometrist and anthropometry sources such as the RMSS (1994), Norton and Olds (1996) and ISAK (2001).

Other tools necessary for the taking of body dimensions included land markers. These were white stickers with a circular hole in the middle. They were placed on the relevant positions of the body and body suits (leotards) as landmarks (Beazley, 1996). Elastic tapes were used for locating indented waist dimension. Hair clips were required to hold hair away during measuring the subjects. Body suits were provided in standardized sizes and brassieres were provided whenever necessary. The measuring area was prepared well in advance for convenience and speed of handling equipment and to reduce the fatigue of both the subject and the measurer. This therefore contained a stationed table on the right hand side of the measurer with all the equipment and tools arranged according to the order of measurements given on the body measurement data-capturing sheet.

Measurements (dimensions) from a person can only be accurate and representative if they are taken accurately by correct methods, instruments and techniques employed (Ashdown, 2000; Simmons & Istook, 2003; Bye *et al*, 2006). However, accuracy is enhanced when the subjects are land marked prior to taking measurements. This ensures conformity and consistency while taking body dimensions (Simmons & Istook, 2003). Since a land marking exercise requires palpation, touching and sometimes bending of parts to

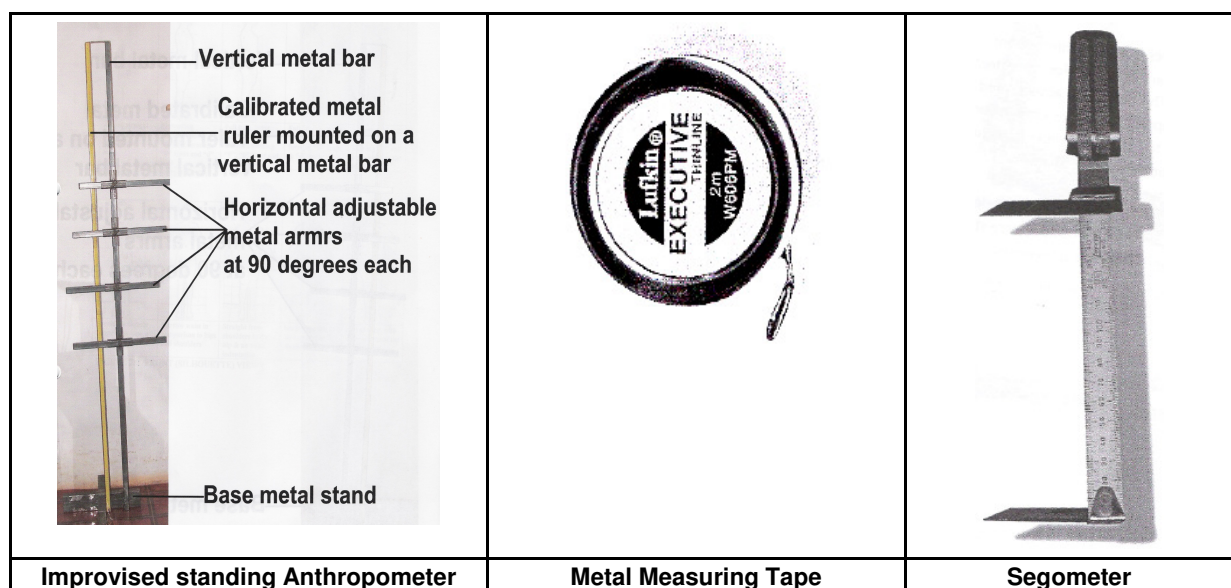


FIGURE 1: MEASURING INSTRUMENTS

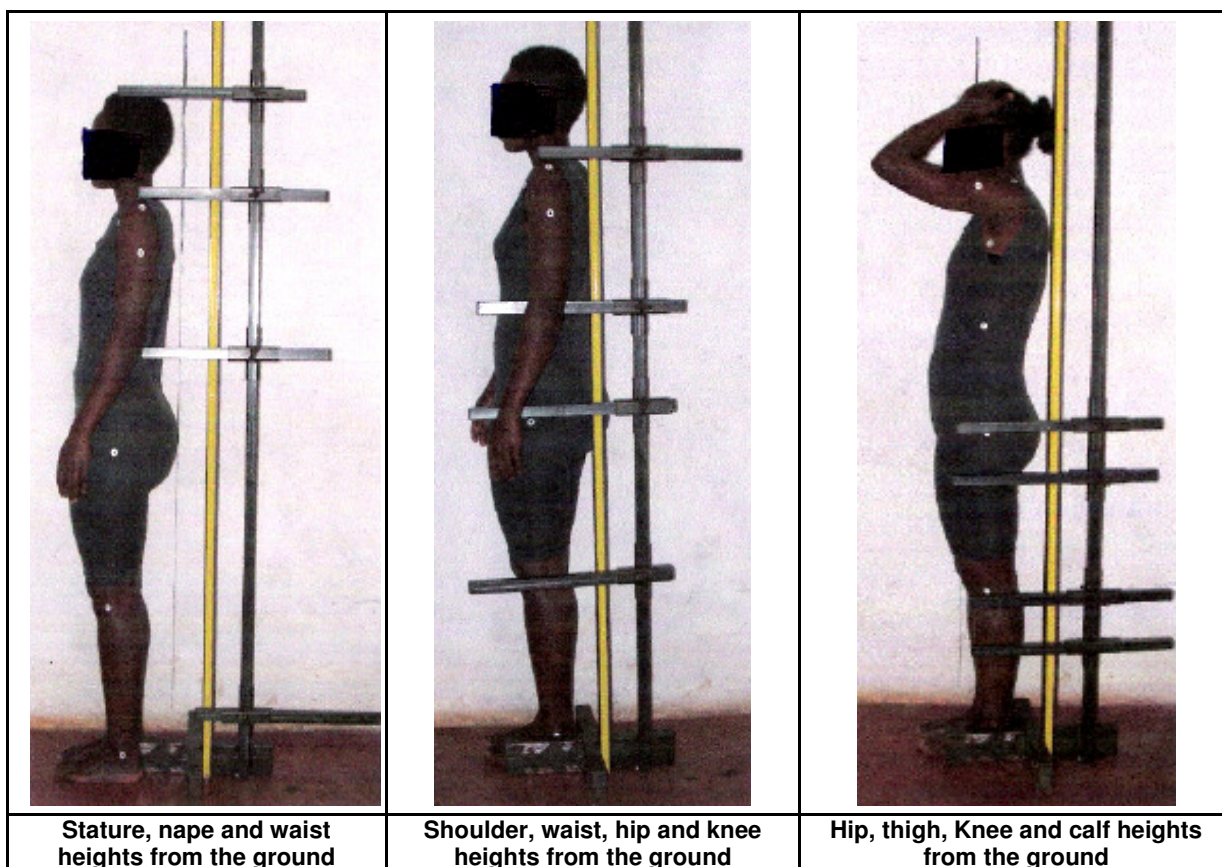


FIGURE 2: HEIGHT MEASUREMENTS USING STANDING ANTHROPOMETER

find appropriate positions for the needed measurements, participants' privacy is violated in the process (Istook *et al*, 2003; Simons & Istook, 2003). Having observed the resistance of the women's participation with the exercise, it was necessary to continue with negotiations throughout the procedure as recommended by Neumann (2000:352). Most of the participants allowed minimal contact as much as possible and this demanded that the earlier planned landmarking positions be adjusted to include only a few important points (refer to figure 3). The procedure used for land marking followed standardized methods as stipulated in Beazley (1996), ISAK (2001) and Simons and Istook (2003) (Figure 3):

- ◆ The neck/nape (7th cervical vertebra): The subject assumed a relaxed position with hands hanging down the sides and the head in the Frankfort plane position. The landmark was obtained by bending the neck forward to locate it, as it protrudes when the head is lowered. This position was marked with the circular hole on the sticker, being placed on the centre (RMSS, 1994; Beazley, 1996). This landmark guided calculation of the shoulder slope, which was obtained by subtracting shoulder to ground measurement from nape to ground measurement.
- ◆ The shoulder point (acromion): The subject assumed a relaxed position with hands hanging down the sides and the head in the Frankfort plane position. Acromio-clavicular joint positions on both right and left sides were determined by palpating along the spine of the scapula to the corner of the acromion. Marking was applied with the stickers' central holes placed at the midpoints of the acromions (ISAK, 2001:29; McConville, in Simmons & Istook, 2003). The shoulder landmark guided the calculation of the shoulder slope. It also acted as part of the points used to attain the side seam line (profile trunk line).
- ◆ The armpit (axilla) level: The subject's hands were raised and with the head in the Frankfort plane position. Landmarks with stickers' central holes were placed at the midpoints of the hollow armpit regions. This landmark guided the bust extension measurement and the bust measurement. It also acted as part of the points used to attain the side seam line (profile trunk line).
- ◆ The upper arm/biceps point: The subject assumed a relaxed position with arms hanging down the sides. Site is located at the mid-point of the straight line joining the acromiale and radiale, perpendicular to the long axis of the arm also appearing as the fullest part of the biceps region. This landmark guided the upper arm circumferential measurements.
- ◆ The breast tips/bust level: The subject assumed a relaxed position with hands hanging down the sides and the head in the Frankfort plane position. Marking was then applied with the stickers' central holes placed at the breast tips. This landmark guided the bust extension measurement and the bust circumference measurement.

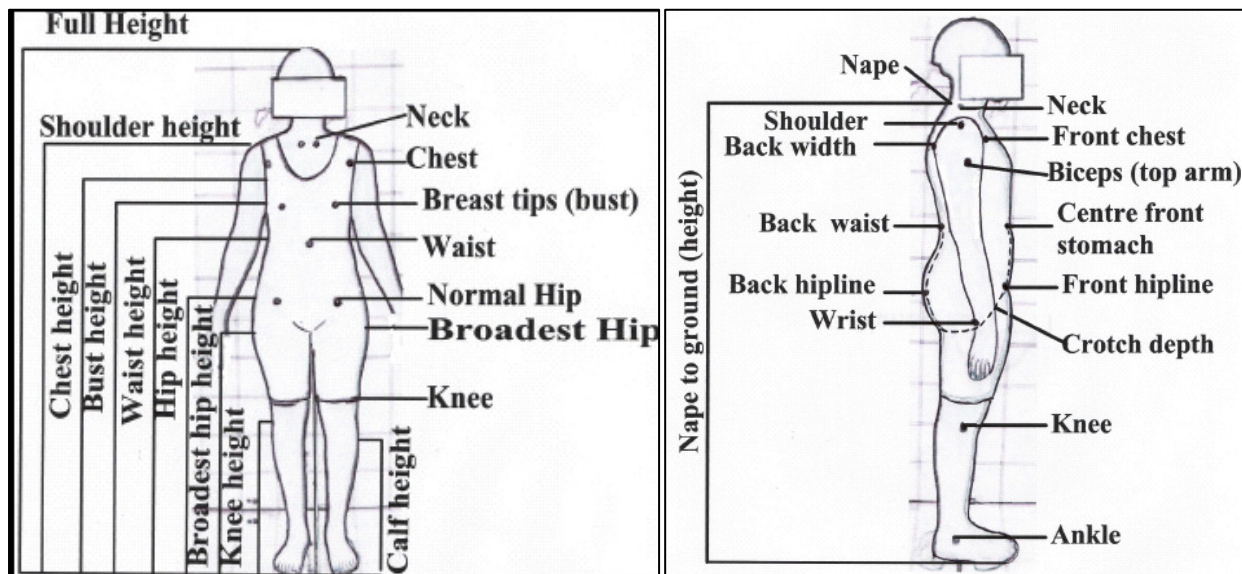


FIGURE 3: LANDMARKS AND BODY DIMENSIONS ATTAINED FOR BODY SHAPE CLASSIFICATIONS

- ◆ The waist: The subject assumed a relaxed standing position with the arms folded across the thorax and the head in the Frankfort plane position. The landmarks with stickers' central holes were placed at the midpoints of the natural waist indentation at the sides. Subjects with waistlines difficult to identify in a relaxed standing position, were requested to bend side ways to facilitate locating the indented waistline. This landmark served as a guide for measuring waist circumferences, and part of the points used to attain the side seam line (profile trunk line) (ISAK, 2001:87).
 - ◆ The hip (trochanterion): The subject assumed a relaxed standing position and with the arms folded across the thorax and the head in the Frankfort plane position. The site was identified by palpating the lateral aspect of the gluteal muscle with the heel of the hand until the superior surface of the hipbone (trochanter) can be felt when strong downward pressure is applied. For subjects with thick adipose tissue over the hipbone it is difficult to locate this. However, while supporting the left side of the subject's pelvis, the subject is requested to lift up the right leg as the palpation continues. This landmark served as a guide for measuring hip/buttock circumferences at the level of their greatest posterior protuberance and as part of the points used to attain the side seam line (profile trunk line) (ISAK, 2001:87).
 - ◆ The thigh bulge point (almost at gluteal furrow point): With the subject assuming a relaxed standing position, the arms folded across the thorax and the head in the Frankfort plane position, the landmark was located at the broadest (bulging) part of the thigh. This landmark served as a guide for measuring lower hip circumference (appearing broadest), and part of the points used to attain the side seam line (profile trunk line) (ISAK, 2001:87). It also guided the calculation of the thigh bulge, which was obtained by subtracting hip circumference from the lower hip circumference (hip appearing broadest).
 - ◆ Knee level (tibiale laterale): With the subject assuming a relaxed standing position and with the arms hanging down the sides or folded across the trunk and the head in the Frankfort plane position, the site was identified by palpating to locate the lateral condyle of the femur and the antero-lateral portion of the lateral border of the head of the tibia. Although it is a difficult site to locate, the subject is requested to flex and extend the knee several times to ensure that correct position has been located, alternatively the subject bends the knee slightly to define the crease line, the mid part on the side is identified and land-marked (RMSS, 1994; ISAK, 2001). This landmark served as part of the points used to attain the side seam line (profile trunk line).
 - ◆ The ankle (malleolus): The subject assumed a relaxed standing position, arms hanging down the sides or folded across the trunk and the head in the Frankfort plane position. The lower edge of the tibial bone was located and land-marked. This landmark served as part of the points used to attain the side seam line (profile trunk line).
 - ◆ Trunk line (side seam): With the subject assuming a relaxed standing position, the ear hole (external auricular meatus) served as the head's landmark, while the shoulder, armpit, natural waist indentation, hip (trochanterion), knee (tibiale laterale) and the ankle (malleolus) served as the other landmarks.
- Measurements were taken according to the standards stipulated in Beazley, 1996; Beazley, 1998:269; ISO, 1989: 6; ASTM-D 5219-99; ISAK, 2001 and Simmons & Istook, 2003. All these sources have well documented standards of obtaining body measurements for apparel design purposes.
- The researcher took all measurements and called out the readings to her research assistant for recording purposes. To confirm that the measurements were correctly recorded, the research assistant loudly an-

swered what she had heard. The research assistant was also skilled in apparel design, and had been trained prior to the fieldwork. She also assisted with aligning of the metal tape measure at the back while circumferential measurements were taken and thus acted as a mirror for the measurer where she could not see or reach.

Photographs: Based on the study of somatography (Salusso-Deonier *et al*, 1991; Kuma, 1999:39) 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. Photographs were taken with a digital camera. A professional photographer trained the researcher in the use of digital photography for this research. Female participants were photographed using standardized methods while dressed in body suits and assuming different positions (front, back and side/profile). The different views facilitated proficient judgment about body components that are critical to apparel items' fit. Those components of the body could therefore be visually analysed and categorized.

In order to achieve consistency and reliability when photographing, all sets of photographs were taken from the same distance with the subjects and photographer taking the same postures and positions. Six-metre guiding grid paper was mounted on the wall at the back and extended to the front on the floor. The extended section on the floor had two footmark positions. The first one was close to the wall and was the subject's position, while the second mark was further away from the wall and served as the photographer's position. The grid paper was made of 15 cm squares with a bolded mid-line, which served as a balancing point when photographing. The background (grid paper) was to standardize all photographs taken and to allow for better judgment later when analysing each

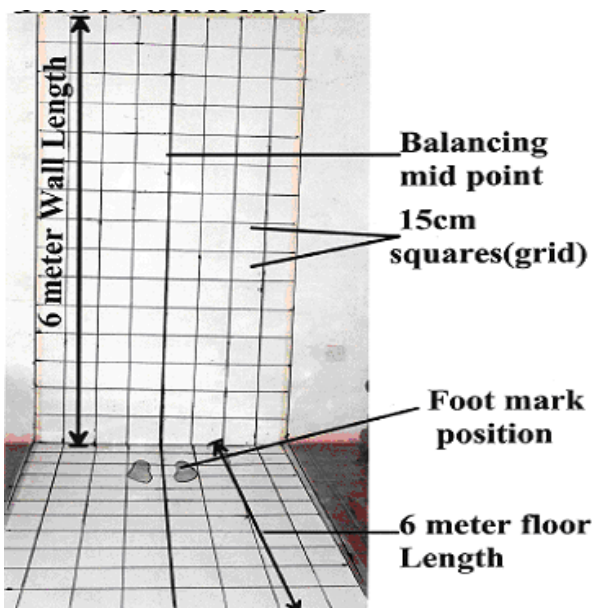


FIGURE 4: PHOTOGRAPHING STUDIO SET UP

shape (Figure 4). All the sets of photographs were taken from the same position and distance while the subjects took specific standardized stances and were dressed in similar styled and neutral (grey) body suits/leotards to ensure uniformity and clarity during evaluation (Figure 5) (Kuma, 1999:39; Anderson *et al*, 2001; Ashdown *et al*, 2004).

To facilitate easy identification of the sets of photographs during analysis, three digit numbers were assigned to the subjects as they were photographed, while their privacy was ensured as their heads were masked (Kuma, 1999:39). Photographs were taken from the front, side and the back as shown in Figure 5. Subjects were requested and assisted regularly to assume and hold an erect stance with the head in the Frankfort plane position and directly on the footmarks with the grid central line passing through their mid-points. With the training experience of the researcher, the use of a quality digital camera and the standardized distance position as well as focus points applied consistently during the entire exercise, reliability of the exercise was ensured. Trained sensory evaluators for purposes of sorting out and identifying most distinct body shapes later evaluated all the photographs.

Analysis of the Data

Body dimensions (height and drop values) were first determined and the Mean and Standard Deviations were calculated for the total group's dimensions deemed important for height categories, identification of distinct body shapes and distinct body features. The Mean Values \pm 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). The medium categories were classified by "Mean \pm SD". Values above the "Mean \pm SD" were classified as large, whereas values below the "Mean \pm SD" were classified as small. Beazley (1998) and Gupta and Gangadhar (2004) applied descriptive statistical techniques in their studies. Statistics used were descriptive methods that integrated simple percentiles to combinations of uni-variate and bi-variate analyses. Uni-variate analysis refers to the analysis of one variable at a time. An example is a frequency/percentage table (Bryman & Bell, 2007:357). Bi-variate analysis is concerned with the analysis of two variables at a time in order to uncover whether or not the two variables are related (Bryman & Bell, 2007:360). Data were normalized giving ranges of two Standard Deviations either side of the Mean Value, which covered 95% of the population where applicable. This removed the extreme dimensions in a range, which could cause distortion.

The drop values used for identifying body shapes were the difference between the bust and the hip dimensions and the difference between the bust and waist dimensions. The range (maximum and minimum) dimensions of the drop values within the context of anthropometric data of this study were used to sort out different shapes based on the five prevalent shapes (hourglass, triangle, inverted triangle, apple

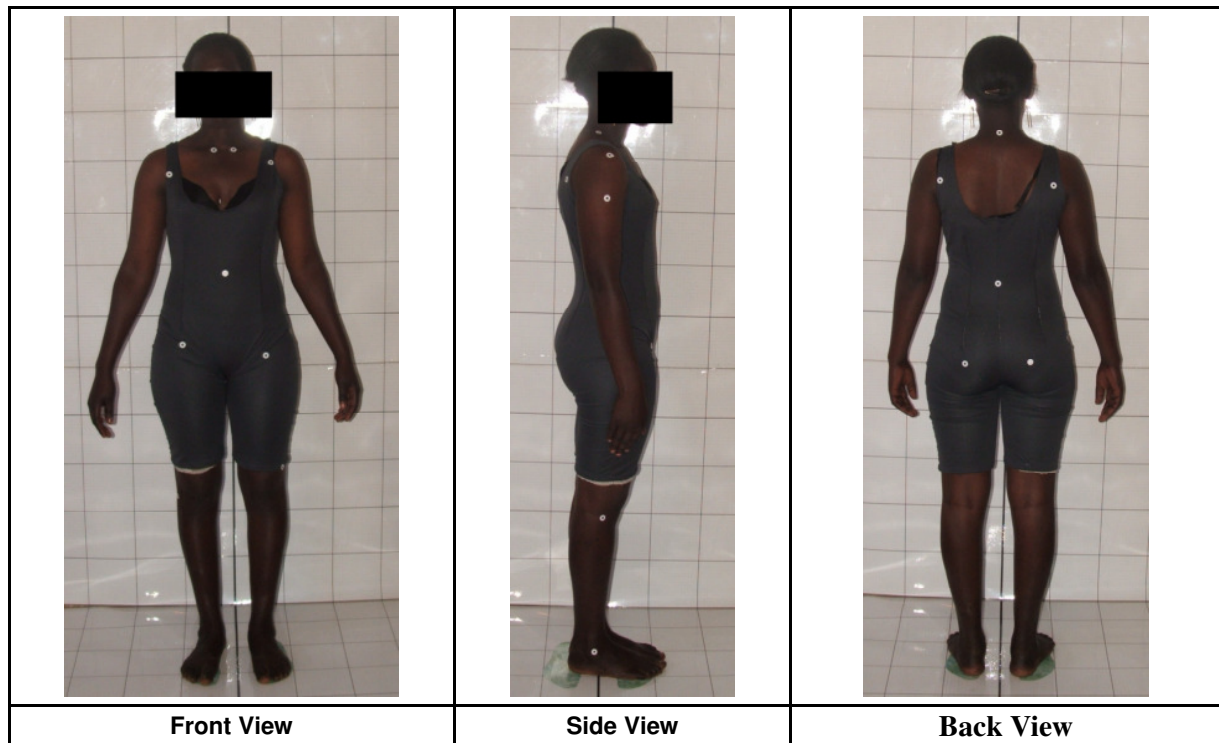


FIGURE 5: DIFFERENT VIEWS OF BODY SHAPES

and rectangular) (Beazley, 1998; Gupta & Gangadhar, 2004; Shin & Istook, 2007).

For the purposes of trustworthiness and reliability of the visual evaluations, the researcher prepared a comprehensive training manual and a body shape assessment-scoring sheet/scale after a thorough review of literature and critically analysing the field photos in a chronological order. It was reasoned that accuracy in evaluations could be achieved if there were some form of agreement between different evaluators and through a unified method of assessment. Standardization would be achieved once the universal bodies' body shape characteristics and how to spot them out on the body were identified and well understood. The development of the training manual was therefore necessary to facilitate some form of unanimity between evaluators during assessments of the body shapes. According to Fan (2004:28), assessors who do subjective assessments may have different internal assessment scales to rate an observation, thus the necessity to train them so as to bring each member of the panel as near to an identical scale as possible. Based on a thorough review of the literature and the outcomes of the preceding steps of the female body shape assessment formula, it became possible to develop a comprehensive manual for the purposes of training.

Slater (1997), cited by Fan (2004:29), points out that in subjective assessment, results could be affected by factors such as subject's personality, skills, state of mind and health. In order to ensure validity and reliability for this method of study, the quality of the evaluators, the assessment procedure, assessments

scaling as well as analysis methods were carefully considered. It has been pointed out that use of trained professional assessors ensures that the differences perceived are smaller (Slater in Fan, 2004:29). An expert panel in a testing atmosphere works as a sensitive test instrument, capable of providing valid and reliable responses to the sensations being studied (ASTM, 1999:5). This implies that well-trained professional evaluators would give more reliable judgments than non-professionals.

It is important that the visual parameters are established and clearly defined for the evaluators. The training and the subsequent assessment scale had, in this case, clearly defined body characteristics that served as visual parameters. Two evaluators with professional experience of 14 and 25 years in the field of apparel design and manufacture were believed to be experts and qualified enough for the assessment of the body shapes in this study. As both evaluators were experts in apparel design and manufacture, which involves the understanding of the human figure and translating it into apparel, each evaluator independently studied the training manual and practiced with similar stimulus material (sample photos). This helped them to understand the clearly defined visual parameters necessary for the assessment of the images. The professional evaluators later met to resolve any misunderstanding arising from the training manual and to improve the scoring sheet. This provided a standardized and sequential way of assessing and recoding evaluation of the photos.

An average Kappa value of 0.66 demonstrated moderate inter-rater reliability. Although this was a lower

statistic than was expected, it compares well with inter-rater Kappa values from previous body shape research (Connell *et al*, 2006). Significant tests with Kappa ($p < 0,0001$) suggested that there were no complete disagreement between the two evaluators. In cases where the inter-rater reliability was below the Kappa value of 0,75, the specific assessment was subjected to a trained group of expert evaluators for further evaluation.

LIMITATIONS AT GRASSROOTS LEVEL

While the researchers had anticipated some negative reactions, it was minimised in the mind and, in the event, the extent was overlooked. In the field, some of the school principals (gatekeepers) of the private schools refused access to their schools. Although Neumann (2000:352) warns that bargains and promises of entry may not remain stable over time and may require that the researcher returns later for renegotiating, the decision to exclude all the private schools in the two regions was made because time and limited finances could not accommodate any further errors. This decision necessitated new lists of government schools only to be sought from the Ministry of Education's offices within the respective regions. The new lists were then used for re-sampling purposes. Babbie and Mouton (2001:299, 310) state that most field research offers no fixed rules in methodology to follow, because sometimes, sampling criteria emerge from the fieldwork. Although the new lists had fewer schools, the original sample sizes of 151 and 150 participants from the two regions respectively, were maintained. Systematic sampling techniques remained in force as had been planned and the procedures were maintained.

Having initially gone to schools for negotiations with the school principals, it was there at school level that the first rejection was encountered, and a research permit was demanded. This encounter signalled that there were more powerful gatekeepers that needed to be identified and to build a trusting relationship with them, as Hammersley and Atkinson (1995: 65) warns. It also confirmed Hammersley and Atkinson's (1995:54) statement that researchers have to rely on their own resources, strategies and skills to get access to suitable participants. Strydom (2002:283) also cautions that in some cases, gatekeepers and other sensitive obstacles may prevent one gaining access to the field. Having been rejected and a research permit demanded the researcher had to apply for a research permit from the Ministry of Education before commencing the research. A research proposal had to be submitted for scrutiny and approval had to be obtained from the Ministry so that the research permit could be granted. Neumann (2000:353) points out that disclosing the project to the highest ranking gatekeepers is one way of developing trust, and subsequently a step forward towards entry to the field. At least the research permit was granted, but revealed different authorities (gatekeepers) to report to in every region that the study was to be undertaken before the research could commence.

Socio-cultural differences that often lead to divergence in perceptions, beliefs and behaviour, include geographic locations, ethnicity, religion, and sexual orientation (Fiore & Kimle, 1997:86; Marshall *et al.*, 2004:94). Considering the nature of the study, taking body dimensions and photographing female career women wearing minimal apparel is a delicate matter, also observed by Apeageyi *et al* (2007). It required caution, patience and deep understanding of the participants' cultural and religious beliefs, even before negotiating with them. The researcher, after seeking permission from the school principals comprehensively explained the objectives and the importance of the study to the staff members (potential participants of the study). The researcher then requested them to volunteer from their own free will. As soon as agreements were made, those who were willing to participate were requested to decide on a suitable date and time for the measurements and photographs to be taken. Initially, all participants volunteered, were positive and accepted unanimously to participate. Later on, the majority accepted to complete the accompanying questionnaire but declined to be measured and photographed. When undertaking a sensitive study in a new country, the cultural limitations must be well understood beforehand, and even then, room should be allowed for any eventualities. It would be wise to move away from an egocentric view, because each social cultural context shapes the individual's thoughts, beliefs and feelings towards any activity that, in one way or the other, would infringe upon their privacy within their cultural and/or religious beliefs. In this specific study, in one case, a few participants turned up for measurements and photographs. Alarmingly, in the middle of the exercise, administrative police from the chief's camp in the locality of the study, accompanied by some unidentified women, stormed the studio and demanded that the exercise be stopped. The security staff accompanying them and the women cited witchcraft, cultural/religious beliefs and pornography as the main reasons why the exercise should not proceed. Nevertheless, after producing a research permit and other supporting documents from the different gatekeepers, the researcher was allowed to proceed. Babbie and Mouton (2001:309) observe that qualitative researchers may meet with several levels of attitude and actions, but flexibility, as a chief benefit of qualitative research, permits one to amend the research plan any time and adapt the methodology and other aspects of the study to suit the object of the study. Neumann (2000:346) points out that a researcher's direct participation in the field often has an emotional impact. Although the damage as a result of humiliation had already been done, the exercise on that particular day proceeded, but dejectedly. Time was running out and therefore a new strategy had to be devised on the spot. According to Hammersley and Atkinson (1995:55) it is imprudent to allow one's strategy to be lead entirely by one's own perceptions concerning what is and is not accessible. Despite the refusal to participate, a renegotiation process was still achievable as recommended by Neumann (2000:352). A new tactic was devised and approached with caution and patience. Having interacted

with the teachers, the researcher identified skilled and influential (vocal) members with apparel and textiles skills, to be used as pioneers as well as negotiators/recruiters and persuaders of other participants. The vocal members convinced a few other members who also identified others for the exercise. This recruiting exercise went on until there were no further persons willing to participate from each specific school. This resulted in snowball sampling within the initial (already) systematic sampled groups in different schools. Out of the population of 301 people that was initially pre-determined by the researcher, only 123 bodies were measured and 89 sets of photographs were taken. This, therefore, agrees with Babbie and Mouton's (2001:310) viewpoint that in an interpretive research design, two types of sampling are commonly found, one where the researcher sets up sampling before commencing with the fieldwork and another where sampling criteria emerge from the fieldwork.

Neumann (2000:349) observes that steps taken in a field project are not completely programmed but rather serve as an estimated guide or road map. As a re-entry strategy, the researcher and the research assistant were forced to develop stronger trust and rapport with the participants by providing their own photographs 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 (snowball sampled group) all over again. Some apparel items with fit problems were used to demonstrate how body shapes influence the fit of apparel, as a point to drive home. Neumann (2000:352) reports that the researcher has to continuously negotiate and explains the research objectives of the study time and again in the field.

Although a thorough explanation was made before each exercise, it must be reported that human beings are difficult to control and have them stationary in one position. Most of the landmarks were applied on the body suits and not directly on the body except for the neck, nape, shoulders, biceps, chest, and back width positions. The stickers in most cases would shift and sometimes fall off as the participants moved. The positioning of each individual in a recommended manner was always a problem as even the slightest movement such as breathing, coughing or even stretching a little, would alter the intended position. Most subjects wore wrong-sized and -shaped brassieres, which also affected positioning of the breasts points. Even when brassieres were provided for them, or straps of their own adjusted, slight movements on the subject would still affect the landmarks and their positions. It was observed that frequent adjustments of the brassieres also made the participants uncomfortable. However, the researcher managed to obtain all the measurements through standardized methods stipulated in ISO (1989), Beazley (1996), ASTM (1999), and ISAK (2001).

It should be noted that such a measurement exercise is very tiring to both the measurer and the participant being measured. It took approximately 25-30 minutes to measure one person. Most participants felt uncom-

fortable being measured on some parts of the body, for example, crotch depth, bust tips and bust depth. These measurements were taken after a demonstration on the researcher herself. The improvised anthropometer was very effective except that it is heavy and cumbersome to carry.

CONCLUSIONS

The researchers succeeded with the identification of two unique body shapes, typical for the Kenyan women, who seemingly resemble two of the established Western body shapes, but are in effect totally different from the established Western body shapes. Digital photography produced quality front, back and profile images that enabled the evaluators to come up with clear assessments. The two body shape identification techniques produced corresponding results. However, the researchers are of the opinion that, 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 facilitate comprehensive scrutiny on the size/depth of any contours and any outlines that appear on the body. It is therefore possible to segregate body characteristics with the use of both body shape identification techniques (using body dimensions and evaluations of photographs). Characteristics that were not possible to identify concurrently using both techniques are: the bust and the height proportions (identified through body dimensions), the body build, stomach, upper back curvature, back waist curvature and the top arm (identified through visual evaluations of the photographs).

The results from both body dimensions as well as evaluations of photographs further demonstrate that both techniques, when combined, yield even better results that can address apparel fit problems more usefully. Considering that body scan technology is not popular in developing countries due to its cost and technicalities involved (Xu et al, 2002; Ashdown & Dune, 2006), it may be reasoned that in the meantime both body shape identification techniques (from the dimensions as well as visual evaluations of photographs) could be used simultaneously to produce reliable results.

Executing fieldwork research and generating trustworthy data in third world countries, where a lack of modern technology exists, and where a strong traditional culture in many cases restrains the researcher from following the familiar research strategy, is definitely not an easy task. It asks for a patient, creative, open-minded and totally committed researcher. For the researcher who possesses of these qualities the end result is, however, exciting and fulfilling.

REFERENCES

ALEXANDER, M, CONNELL, LJ & PRESLEY, AB.

2005. Clothing fit preferences of young female adult consumers. *International Journal of Clothing Science and Technology* 17(1):52-64.
- AMERICAN SOCIETY FOR TESTING AND MATERIALS [ASTM]. 1999. *Standard terminology relating to body dimensions for apparel sizing*. D 5219-99. New York. American National Standards Institute.
- ANDERSON, LJ, BRANNON, EL, ULRICH, PV, PRESLEY, AB, WARONKA, D, GRASSO, M & GRAY, S. 2001. Understanding fitting preferences of female consumers: Development of an expert system to enhance accurate sizing selection. *National Textile Center Annual Report* 198-A08. Available online. URL: <http://car.clemson.edu/fit2000/> Accessed on 06/03/2004.
- APEAGYEI, PR, OTIENO, R & TYLER, D. 2007. Ethical practice and methodological considerations in researching body cathexis for fashion products. *Journal of Fashion Marketing* 11(3):332-348.
- ASHDOWN, SP. 1998. An investigation of the structure of sizing systems: A comparison of three multidimensional optimized sizing systems generated from anthropometric data with the ASTM standard D5585-94. *International Journal of Clothing Science and Technology* 10(5):324-341.
- ASHDOWN, SP. 2000. Introduction to sizing and fit research. *Clemson Apparel Research Center*, Available online. URL: <http://car.clemson.edu/fit2000/> Accessed on 06/03/2004.
- ASHDOWN, SP. 2002. *Communication of sizing and fit*. Available online. <http://www.cornell.edu/units/txa/research/ntc/S01-CR01-03.pdf>. Accessed on 06/03/2004.
- ASHDOWN, SP, LOCKER, S & ADELSON, C. 2004. *Use of body scan data to design sizing systems based on target markets*. Available online. <http://www.cornell.edu/units/txa/research/ntc/S01-CR01-03.pdf>. Accessed on 12/01/2005.
- ASHDOWN, P & DUNE, L. 2006. A study of automated custom fit: Readiness of the technology for the apparel industry. *Clothing and Textiles Research Journal* 24(2):121-136.
- BABBIE, E & MOUTON, J. 2001. *The practice of social research*. Cape Town. Oxford University Press.
- BAILEY, KD. 1994. *Methods of Social Research*. New York. Free Press.
- BEAZLEY, A. 1996. Size and fit: Procedures in undertaking a survey of body measurements. Part 1. *Journal of Fashion Marketing and Management* 2(1): 5-85.
- BEAZLEY, A. 1997. Size and fit: Formulation of body measurement tables and sizing systems. Part 2. *Journal of Fashion Marketing and Management* 2(3):260-284.
- BEAZLEY, A. 1998. Size and fit: The development of size charts for clothing. Part 3. *Journal of Fashion Marketing and Management* 3(1):66-84.
- BYE, E, LABAT, KL & DELONG, MR. 2006. Analysis of body measurement systems for apparel. *Clothing and Textiles Research Journal* 4(2):66-79.
- CONNELL, LJ, ULRICH, P, KNOX, A, HUTTON, G, BRUNER, D & ASHDOWN, S. 2003. Body scan analysis for fit models based on body shape and posture analysis. *National Textile Center Annual Report* S01-AC27. Available online. www.explore.cornell.edu/scene.cfm?scene Accessed on 23/04/2003.
- CONNELL, LJ, ULRICH, PV, BRANNON, EL, ALEXANDER, M & PRESLEY, AB. 2006. Body shape assessment scale: Instrument development for analyzing female figures. *Clothing and Textile Research Journal* 24(2):80-94.
- DELONG, M, ASHDOWN, S, BUTTERFIELD, L & TURNBLACK, KF. 1993. Data specifications needed for apparel production using computers. *Clothing and Textiles Research Journal* 11(4):1-7.
- FAN, J. 2004. Perception of body appearance and its relation to clothing. In Fan, J, Yu, W & Hunter, L. (Eds). *Clothing appearance and fit: Science and technology*. New York. Woodhead.
- IORE, AM & KIMLE, PA. 1997. *Understanding aesthetics for the merchandising and design professional*. New York. Fairchild.
- IORE, AM, LEE, S & KUNZ, G. 2004. Individual differences, motivations, and willingness to use mass customization option for fashion products. *European Journal of Marketing* 38(7):835-849.
- GUPTA, D & GANGADHAR, BR. 2004. A statistical model for developing body size charts for garments. *International Journal of Clothing Science and Technology* 16(5): 458-469.
- HAMMERSLEY, M & ATKINSON, P. 1995. *Ethnography: Principles in practice*. 2nd ed. New York. Routledge.
- HILLESTAD, R. 1980. The underlying structure of appearance. *Dress* 6: 117-125.
- International Society for the Advancement of Kinanthropometry (ISAK). 2001. *International Standards for Anthropometric Assessment*. Sydney.
- INTERNATIONAL ORGANISATION FOR STANDARDIZATION (ISO). 1989. *Garment construction and anthropometric surveys: body dimensions*. No 8559-1989. Geneva. International Organisation for Standardization.
- ISTOOK, C, LITTLE, T, HONG, H & PLUMLEE, T. 2003. Automated garment development from body scan data. *National Textile Center Annual Report*. S00-NS15. Available online. URL: <http://car.clemson.edu/fit2000/> Accessed on 06/03/2004.
- KENYA BUREAU OF STANDARDS (KEBS). 2001. *Draft Kenya standard specification for size designation for women's and girls' clothing*. Nairobi. Kenya Bureau of Standards.
- KERLINGER, F.N. 1986. *Foundations of behavioral research*. 3rd ed. Fort Worth. Harcourt.
- KUMA, MA. 1999. *Design guideline for selected plus-sized professional black South African women*. M.Tech thesis. Pretoria. Tshwane University of Technology.
- KUNIK, P. 1984. *Sizing pattern construction and grading for women and children's garments*. London. Philip Kunik.
- LEIBOWITZ, HW & POST, RB. 1982. Capabilities and limitations of the human being as a sensor, selected sensory methods; problems and approaches to measuring hedonics. In Kuznick, JT, Johnson, RA & Rutkiewicz, AF. *Selected sensory methods: problems and approaches to measuring hedonics*. American Society for Testing and Materials. STP 773. Philadelphia. ASTM.
- LYON, DH, MENNEER, JL, MCEWAN, JA, METHER-

- INGAHAM, TLC & LALLEMAND M. 2000. *Guidelines for the selection and training of assessors for descriptive sensory analysis*. Budapest. Campden and Chorleywood Magyarorszag.
- MARSHALL, SG, JACKSON, HO, STANLEY, MS, KEFGEN, M & TOUCHIE-SPECHT, P. 2004. *Individuality in clothing selection and personal appearance*. 6th ed. New Jersey. Pearson Education.
- NEUMANN, WL. 2000. *Social research methods*. 4th ed. Boston. Allyn and Bacon.
- NORTON, K & O'LDS, T. 1996. *Anthropometrica. A textbook of body measurements for sports and health courses*. Sydney. University of Wales Press.
- OTIENO, R, HARROW, C & LEA-GREENWOOD, G. 2005. The unhappy shopper, a retail experience: exploring fashion, fit and affordability. *International Journal of Retail and Distribution Management* 33(4):298-309.
- PETROVA, A. 2007. Creating sizing systems. In Ashdown, SP. 2007. *Sizing in clothing developing effective sizing systems for ready- to-wear clothing*. New York. Woodhead Publishing.
- REPUBLIC OF SOUTH AFRICA MILITARY STANDARDS (RMSS). 1994. RSA-MIL-STD-127, 1(4): 1-264.
- SALUSSO-DEONIER, CJ. 2005. *The body as a framework for apparel*. Available online. <http://www.wsu.edu:8080/salusso/BODY/contents.html>. Accessed 20/01/2005.
- SALUSSO-DEONIER, C, MARKEE, NL & PEDERSEN, EL. 1991. Developing realistic stimuli for assessing observer's perceptions of male and female body types. *Perceptual and Motor Skills* 72:603-610.
- SIMMONS, KP & ISTOOK, CL. 2003. Body measurement techniques, comparing 3-D body-scanning and anthropometric methods for apparel applications. *Journal of Fashion Marketing and Management* 7 (3):06-332.
- SIMMONS, K, ISTOOK, CL & DEVARAJAN, P. 2004. Female figure identification technique (FFIT) for apparel. Part 1: Describing female shapes. *Journal of Textile and Apparel, Technology and Management* 4 (1):1-16.
- STRYDOM, H. 2002. *Information collection: Participant observation*. In De Vos, AS. *Research at grass roots*. 2nd ed. Pretoria. Van Schaik.
- STRYDOM, H & VENTER, L. 2002. Sampling and sampling methods. In De Vos, AS. *Research at grass roots*. 2nd ed. Pretoria. Van Schaik.
- ULRICH, PV, ANDERSON-CONNELL, LJ & WU, W. 2003. Consumer co-design of apparel for mass customization. *Journal of Fashion Marketing and Management* 8(4):398-412.
- WINKS, JM. 1997. *Clothing sizing, international standardization*. The Textile Institute, London. Redwood Books.
- XU, B, HUANG, Y, YU, W & CHEN, T. 2002. Body scanning and modeling for custom fit garments. *Journal of Textile and Apparel, Technology and Management* 2(2):1-11.