SIZING FOR ETHNICITY IN MULTI-CULTURAL SOCIETIES: DEVELOPMENT OF SIZE SPECIFICATIONS FOR YOUNG SOUTH AFRICAN WOMEN OF AFRICAN DESCENT

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OPSOMMING

Die huidige stelsel van Suid-Afrikaanse klederinggroottes word gebaseer op die Westerse ideale liggaamsvorm. Maar die meeste Suid-Afrikaanse vroue van Afrika-afkoms het 'n driehoekige liggaamsvorm. Die driehoekige liggaamsvorm verskil van die Westerse ideale liggaamsvorm waarop klere wat dragereed ('ready-to-wear') is, tans gebaseer word, en dit is 'n bydraende faktor tot die probleme wat Suid -Afrikaanse vroue van Afrika-afkoms ondervind met die kwaliteit van passing van sodanige dragereed-kledingstukke. Die doel van hierdie studie was derhalwe om grootte-spesifikasies te ontwikkel vir jong Suid-Afrikaanse vroue van Afrika-afkoms met driehoekige liggaamsvorme. Die grootte-spesifikasies is ontwikkel vir jong vroue van medium lengte, ouderdom tussen 18 en 25 jaar, en wat in die 6/10- tot 14/38-groottereeks val. Die antropometriese data wat in die studie gebruik is, is verkry uit 'n substel van die antropometriese databasis wat in Makhanya *et al* (2014) gebruik is. Die metodologie van die ontwikkeling van die grootte-spesifikasies was soos volg: selektering van die horisontale sleuteldimensies, bepaling van die groottereeks, en berekening van die sekondêre dimensies. Ten einde die horisontale sleuteldimensies te selekteer, is Pearson se korrelasiekoëffisiënt (r_{xy}) in Microsoft Excel bereken. Die borsmaat het oor die algemeen beter korrelasie met meeste van die horisontale mate getoon, vergeleke met die korrelasie tussen die heupe en meeste van die horisontale mate. Die borsmaat is derhalwe geselekteer as die horisontale sleuteldimensie vir die studie. Ten einde die groottereeks vir die grootte-spesifikasies te bepaal, is die antropometriese data in verskillende groottes verdeel, volgens die huidige industriepraktyk. Meeste van die antropometriese data het in die 6/30- tot 14/38-groottereeks geval; die groottereeks was dus beperk tot hierdie groottes. 'n Statistiese tegniek genaamd kleinstekwadrate-regressieontleding ('least-squares regression analysis') is gebruik om die sekondêre dimensies te bereken, weens die klein grootte van die steekproef van antropometriese data wat in die studie gebruik is. Die grootte-spesifikasies wat in die studie ontwikkel is en die grootte-spesifikasies wat in die Suid-Afrikaanse kledingindustrie gebruik word, is vergelyk, om die kernverskille tussen die voorgestelde grootte-spesifikasies en die grootte-spesifikasies wat in werklikheid in die Suid-Afrikaanse kledingindustrie gebruik word, te illustreer. Die vergelykende ontleding het aangedui dat jong Suid-Afrikaanse vroue van Afrika-afkoms met 'n driehoekige liggaamsvorm 'n losserige passing mag ervaar in die bolyf-gedeelte van kledingstukke wat gemaak is ooreenkomstig die grootte-spesifikasies wat tans in die Suid-Afrikaanse kledingindustrie gebruik word.

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INTRODUCTION

Despite the availability of a wide variety of national and international apparel brands, fit problems continue to plague South African female consumers of all ethnic backgrounds (Makhanya *et al*, 2014). Findings of studies conducted on apparel fit satisfaction have repeatedly shown that many women are dissatisfied with the fit of ready-to-wear apparel (Pisut & Connell, 2007; Loker *et al*, 2005). The biggest complaint concerning apparel products, according to Keiser and Garner (2008:368), is that consumers cannot find apparel that fits. In Africa, research findings indicate that contemporary apparel sizing is inadequate in providing African women with acceptable quality of fit (Mastamet-Mason, 2008:204; Zwane & Magagula, 2007). According to Mastamet-Mason (2008:204), 65% of women in Kenya reported problems with the fit of apparel at various fit points of the upper and lower torso.

Dimensions of the human body are the foundation of any effective sizing system and consequently better fitting apparel. Body shape and body size vary between consumers from different ethnic backgrounds; however, ready-to-wear apparel is designed to fit women with the Western ideal body shape (Zwane & Magagula, 2007). Differently shaped consumers therefore require differently shaped apparel to accommodate body shape variations (Lee *et al*, 2007). Apparel students who aim to enter the retail environment, as well as apparel manufacturers and retailers who would like to target diverse multi-cultural markets, such as the South African market, therefore need to be cognizant of the body shape characteristics of different consumer groups.

In their study, which sought to identify and compare the most prevalent body shapes and body shape characteristics of young African and Caucasian women, Makhanya *et al* (2014) determined that by far the most prevalent body shape among the sample of African women was the triangular shape (58,7%), followed by the hourglass shape (27,5%) and the rectangular shape (12,8%). Among the sample of Caucasian women, the most prevalent body shape was the hourglass shape (40,8%), followed by the triangular shape (33,6%) and the rectangular shape (24,6%). It was also found that the body shape characteristics between African and Caucasian women with the same overall body shapes, differ – probably due to ethnic differences. Mastamet-Mason (2014) observes that the Western triangular body shape differs significantly from the African triangular body shape in terms of drop values. The hips of the Western triangular body shape are at least 8,00 cm larger than the bust, whereas the hips of the African triangular body shape are at least 23,00 cm larger than the bust (Ola-Afolayan & Mastamet-Mason, 2013). Despite these differences, the South African apparel industry continues to base apparel production on the body shape and measurements of the Western ideal body shape, while most national and international brands still do not cater for body shape variations. Problems with fit thus arise because of the mismatch between Western sizing systems based on the ideal body shape and the body shapes and sizes of South African ethnic groups. This exploratory study therefore aimed to develop size specifications for young South African women of African descent with the prevalent triangular body shape.

LITERATURE

Sizing systems

Apparel sizing systems guide apparel manufacturers in the sizing and proportioning of ready-to-wear apparel with the aim of providing the majority of consumers, whose precise body measurements are not known, with a well-fitted garment (Pisut & Connell, 2007; Salusso *et al*, 2006; Schofield & LaBat, 2005). Well-fitted garments are comfortable to wear, allow sufficient ease for freedom of movement and are free of undesirable wrinkles (Song & Ashdown, 2010).

An apparel sizing system consists of a series of size charts, with each size chart designed to serve the apparel sizing requirements of each body shape category found within the population (Schofield & LaBat, 2005). A size chart consists of a table of average body measurements artificially divided into different sizes, with each size representing a particular combination of body measurements (Beazley & Bond, 2003:8; Petrova, 2007:57; Schofield & LaBat, 2005). Apparel fit and apparel sizing are interrelated, since the fit of a garment is vastly influenced by its measurements (Sindicich & Black, 2011).

In developing sizing systems, various researchers (Gupta & Gangadhar, 2004; Hsu & Wang, 2005; Hsu, 2009; McCulloch *et al*, 1998; Mpampa *et al*, 2010; Salusso *et al*, 2006) have proposed different methodologies for developing sizing systems; however, according to Petrova

(2007:66) and Schofield (2000:81), the basic methodology of developing a sizing system consists of collecting anthropometric data, dividing the anthropometric data into different body shapes based on key dimensions, determining the size range of the sizing system, calculating the values of the secondary dimensions and the grade between secondary dimensions, and then communicating the sizing system.

Anthropometric data

In South Africa, a representative anthropometric study of South African women has never been undertaken. Furthermore, the South African Bureau of Standards has never published a standard for the sizing of women's apparel. With the lack of an official sizing standard and a publicly available anthropometric database, South African sizing for women's apparel is based on British anthropometric data which was published in 1957 (Strydom & De Klerk, 2006; Zwane & Magagula, 2007). However, small anthropometric surveys of South African women have been conducted by large South African corporations in the apparel industry. The findings of these anthropometric surveys are not available to the general apparel industry but only to the companies sponsoring the surveys (Strydom & De Klerk, 2006).

Body shapes

When creating a sizing system, the first step is to divide the anthropometric data of the population into different categories of body shapes based on the ratio between key dimensions (Schofield & LaBat, 2005; Yu, 2004:185). A key dimension is defined as a measurement that serves as a predictor of other body measurements (Le Pechoux & Ghosh, 2002; Petrova, 2007:63; Strydom & De Klerk, 2006; Yu, 2004:187). According to Petrova (2007:63), the key dimension separates the population into different sizes along the body measurements and is considered the most important measurement for a specific type of garment. Key dimensions are not only important in dividing the population into different sizes. They are also essential for defining the shape of the body. When selecting key dimensions they 'should be chosen so that they are (also) able to describe the body shape of the individual for whom a garment is being made' (Petrova, 2007:66).

Determining the size range

After the key dimensions of the sizing system have been selected and the body shapes encountered in the population have been identified, the ranges of sizes that will accommodate most of the population need to be determined (Petrova, 2007:72). Sizing systems, according to Petrova (2007:64), do not include all possible sizes; sizing systems include only those sizes that are the most populated and will collectively achieve the predetermined accommodation rate of the sizing system. The accommodation rate refers to the percentage of the population that is catered for by a sizing system; it typically falls between 65% and 85% (Petrova, 2007:64). A goal of any sizing system is to divide the population in such a way that a limited number of sizes accommodates most of the individuals in the population (Mullet *et al*, 2009:4; Petrova, 2007:59). In determining the size range, the accommodation range of the sizing system needs to be determined by establishing the maximum and minimum values of the key dimension as well as the size interval (Petrova, 2007:64). A size interval refers to the measurement difference between two adjacent sizes (Cooklin, 1990:42). The value of the size interval together with the desired accommodation range defines the number of sizes in the sizing system (Petrova, 2007:72).

Calculating the secondary dimensions

Once the values of the key dimensions for each of the various sizes have been determined, the values of the additional body measurements that are needed to construct a garment have to be calculated and tabulated, together with the value of the key dimension for each size (Petrova, 2007:64). The additional dimensions are referred to as secondary dimensions, and describe the human body in the detail necessary to construct a garment that will fit the human body (Petrova, 2007:75). Regression analysis is commonly used to calculate the values of secondary dimensions in a sizing system (McCulloch *et al*, 1998; Shin & Istook, 2007). With regression analysis, the values of secondary dimensions for any known values of the key dimension may be estimated (Anderson *et al,* 2003:567; Le Pechoux & Ghosh, 2002; Shin & Istook, 2007).

Sizing standards updates

Although apparel sizing standards are scheduled for updating every five years, the schedule for the updating of sizing standards

has no relationship to the anthropometric surveys that have been conducted (Lee *et al,* 2007). The changes to apparel sizing standards have been based on industry practice and arbitrary calculations, rather than on representative anthropometric data (Lee *et al,* 2007). With the lack of current representative anthropometric data in South Africa, the current sizing used for apparel manufacturing of national and international brands is not representative of the shape and the measurements of contemporary South African women, and certainly not for the most prevalent triangular-shaped African woman. Sizing that reflects the proportions and body dimensions of this consumer group needs to be developed in order to improve the quality of fit of apparel for this consumer group.

RESEARCH OBJECTIVE

This exploratory study aimed to develop size specifications for the body measurements required for a basic sheath dress for South African women of African descent of medium height with a triangular body shape.

METHODOLOGY

Anthropometric data

Young South African women of African descent were selected as the unit of analysis for this study because they are not currently adequately catered for by the current ready-to-wear apparel sizing. With the lack of anthropometric data of the general South African population, the anthropometric data that was used in the study was obtained from a subset of the anthropometric database used in Makhanya *et al* (2014). The anthropometric database consists of three-dimensional body scans of 233 female students of various ethnicities aged between 18 and 25 years enrolled at an urban university in South Africa. Comprehensive details on the anthropometric database are described in detail in Makhanya *et al* (2014). A subset of the anthropometric database representing the unit of analysis, in terms of body shape and ethnicity, was selected for use in the study. In Makhanya *et al* (2014) the most prevalent body shape among the African group (N = 109) was the triangular body shape (58,7%; n = 64).

Selection of the key dimensions

Findings of anthropometric studies indicate that there is no key dimension related to both horizontal and vertical measurements, as horizontal measurements were found to be almost entirely unrelated to vertical measurements (Faust & Carrier, 2010; Gupta & Gangadhar, 2004; Le Pechoux & Ghosh, 2002; Petrova, 2007:67). For well-fitting garments, researchers have suggested selecting a pair of key dimensions that are located in different planes – one for horizontal measurements and another for vertical measurements, as horizontal measurements generally correlate well with each other, and vertical measurements generally correlate well with each other (Gupta & Gangadhar, 2004; Mpampa *et al*, 2010; Petrova, 2007:67).

For horizontal body measurements, the bust girth and the hip girth are commonly used as key dimensions (Schofield, 2000:83). According to the analysis of anthropometric data, the bust girth is a good predictor of the horizontal measurements of the upper torso, while the hip girth is a good predictor of the horizontal measurements of the lower torso (Gupta & Gangadhar, 2004; Le Pechoux & Ghosh, 2002; Petrova, 2007:70). In view of this study's objective of developing size specifications for both the upper and the lower torso, bivariate correlation analysis was performed to determine whether to use the hip girth or the bust girth as the key dimension for the horizontal measurements in this study.

Bivariate correlation analysis, according to Levin and Rubin (1991:505), 'describes the degree to which one variable is linearly related to another' variable, and may thus be used to select a key dimension that has high correlation with other measurements (Le Pechoux & Ghosh, 2002). Both the bust girth and the hip girth were tested for correlation with the other measurements of the upper and lower torso by computing Pearson's correlation coefficient (r_{xy}) in Microsoft Excel.

As is shown in Table 1, both the bust girth and the hip girth have positive correlation with other horizontal measurements. The bust girth generally had better correlation with most of the horizontal measurements, compared to the correlation between the hip girth and most of the horizontal measurements.

With regard to the correlation of the vertical measurements with the bust girth and the hip girth, there is an inconclusive trend. Both the bust girth and the hip girth have weak correlation with most of the vertical measurements. Some of the vertical

TABLE 1: BIVARIATE CORRELATION ANALYSIS (n = 64)

Horizontal measurements	Bust (r_{xy})	Hip (r_{xy})
Bust	1,00#	0,75*
Waist	0,81	0,71
Hips	0,75*	1,00#
Shoulder	0,17	0,15
Across chest	0,37	0,24
Across back	0,33	0,22
Bust span	0,18	0,17
Vertical measurements	**Bust (r_{xy})**	**Hip (r_{xy})**
Centre front	0,01	0,22
Centre back	-0,25	-0,01
Front shoulder height	0,17	0,32
Back shoulder height	-0,30	-0,06
Bust-to-waist	-0,45	-0,24
Side seam	-0,48	-0,24
Waist-to-hip	0,21	0,65
Waist-to-knee	0,18	0,38

(#Perfect correlation: bust vs. bust and hip vs. hip
*Inverse relationship: bust vs. hip and hip vs. bust

measurements were found to have negative correlation with both the bust girth and the hip girth. From the bivariate correlation analysis, it may be concluded that there is a weak relationship between the horizontal measurements and the vertical measurements, since not all vertical measurements increase as the horizontal measurements increase. Faust and Carrier (2010) also found a weak correlation between the vertical measurements and the horizontal measurements.

In view of the findings of the correlation analysis, the bust girth was selected as the horizontal key dimension for the study, as it showed better correlation with most of the horizontal measurements. In Schofield (2000:168), the bust girth was also used as the key dimension.

For vertical measurements, height is used as the key dimension since height strongly correlates with most vertical measurements (Le Pechoux & Ghosh, 2002; Mullet *et al*, 2009:5).

Determining the size range

In determining the size range and the measurement values of the bust girth, the accommodation range of the sizing system needs to be determined first by establishing the minimum and maximum measurement values for the bust girth as well as the size interval (Petrova, 2007:64). The British sizing system was used as a reference because South Africa's sizing for women's apparel is adapted from British sizing (Strydom, 2006:217; Zwane & Magagula, 2007). In this study, a 4-cm size interval was selected for the bust girth, following the guidelines of the current British sizing standard (Aldrich, 2008:12-13). The current British standard prescribes a 4-cm circumference grade for the bust girth for the size 6 to size 20 size range, equivalent to the South African size 4/28 to size 18/42 size range.

With the size interval for the bust girth selected, the next step was to determine the range of measurements for the bust girth that the size specifications will cover. In order to select the range of measurements for the bust girth, the 3D body scans were distributed into different sizes according to current industry practice. A woman wearing size 10/34 is generally considered to have a bust measurement of 89 cm in the South African apparel industry. From the bust measurement of the size 10/34, the bust measurements for the size 4/28 to size 16/42 size range were then calculated by adding or subtracting 4 cm (the size interval) from the bust measurement of the size 10/34.

With the bust measurements for the size 4/28 to size 16/42 size range determined, the range of body measurements that can be accommodated by a particular size were then calculated. According to literature, a person's body dimensions should fall within the grade interval of a specific size in order to obtain acceptable quality of fit from that size (Cooklin, 1995:5). The range of bust measurements that can be accommodated by a particular size were calculated by adding 2 cm to the bust

TABLE 2: DISTRIBUTION OF THE 3D BODY SCANS INTO DIFFERENT SIZES (n = 64)

Size	4/28	6/30	8/32	10/34	12/36	14/38	16/40	18/42
Bust measurement	77,00 cm	81,00 cm	85,00 cm	89,00 cm	93,00 cm	97,00 cm	101,00 cm	105,00 cm
Range of bust measurements	75,10 cm to 79,00 cm	79,10 cm to 83,00 cm	83,10 cm to 87,00 cm	87,10 cm to 91,00 cm	91,10 cm to 95,00 cm	95,10 cm to 99,00 cm	99,10 cm to 103,00 cm	103,10 cm to 107,00 cm
Number of 3D body scans	4,00	11,00	19,00	10,00	8,00	7,00	3,00	2,00

TABLE 3: ESTIMATED REGRESSION EQUATIONS FOR THE SECONDARY HORIZONTAL DIMENSIONS

Secondary horizontal dimensions	Intercept ($\hat{y}$)	Slope (b_1)	Regression equation
Waist	3,67	0,82	$\hat{y} = 3,67 + 0,82x$
Hips	14,44	1,01	$\hat{y} = 14,44 + 1,01x$
Shoulder	6,08	0,06	$\hat{y} = 6,08 + 0,06x$
Across chest	4,51	0,30	$\hat{y} = 4,51 + 0,30x$
Across back	16,49	0,18	$\hat{y} = 16,49 + 0,18x$
Bust span	10,61	0,09	$\hat{y} = 10,61 + 0,09x$

measurement of a particular size to determine the upper limit of the size, and by subtracting 2 cm from the bust measurement of a particular size to determine the lower limit of the size. The 3D body scans were then distributed into different sizes based on the range of the bust measurements (Table 2).

Calculating the secondary dimensions

The calculation of the secondary dimensions and the grades between the secondary dimensions was executed in separate steps, as the bivariate correlation analysis indicated a weak correlation between the horizontal measurements and the vertical measurements; therefore, different statistical techniques were required to calculate the horizontal secondary dimensions and the vertical secondary dimensions for the size specifications.

In the sizing of apparel, various statistical methods 'ranging from simple percentiles to complex combinations of multivariate and regression analyses' have been employed (Le Pechoux & Ghosh, 2002:16). In this study, simple univariate statistics were used to calculate the secondary horizontal dimensions. Developing size specifications based on the findings of a small anthropometric survey, as is the case in this study, required simple univariate statistics because complex multivariate statistics require a large sample of anthropometric data to produce worthwhile results (Beazley, 1998).

The univariate statistical technique of least-squares regression analysis was selected to calculate the secondary horizontal dimensions due to the small sample of anthropometric data used in the study. Least-squares regression analysis, in terms of apparel sizing, may be defined as a statistical technique in which the values of secondary dimensions may be predicted from known values of the key dimension (Field, 2009:198; Le Pechoux & Ghosh, 2002). Regression analysis is commonly used to estimate the dimensions of the body from size-to-size (Le Pechoux & Ghosh, 2002; McCulloch *et al*, 1998; Shin & Istook, 2007).

In least-squares regression, and in terms of apparel sizing, the key dimension is considered as the independent variable (*x*-variable), as it explains the change that occurs in the secondary dimensions (*y*-variables/dependent variables) (Anderson *et al*, 2003:631). The bust girth was used as the independent variable for the regression analysis as its correlation with the secondary horizontal dimensions may enable it to predict the secondary horizontal dimensions accurately (Kranzler, 2007:108-109). With the bust girth used as the independent variable, estimated regression equations for the secondary horizontal dimensions were then calculated (Table 3).

The bust measurements used in the South African size 6/30 to size 14/38 size range (shown in Table 2) were then substituted into the estimated regression equations for the secondary horizontal dimensions, to estimate the values of the secondary horizontal dimensions for each size. For instance, to calculate the across back measurement for size

12/36, the bust girth for size 12/36 (93 cm) was substituted for x into the regression equation for the across back measurement, as follows $\hat{y}$ = 16,49 + 0.18(93).

Since the aim of the study was to develop size specifications for young women of medium height, the vertical measurements of the 3D body scans had to be grouped into different height groups. In Gupta and Gangadhar (2004), the vertical measurements of Indian women were grouped into three height groups based on the mean and the standard deviation (σ) of height. In this study, following the guidelines of Gupta and Gangadhar (2004), the vertical measurements were grouped into different height groups as follows:

- short height group: ≤ mean-1σ
- medium height group: = mean ± 1σ

tall height group: ≥ mean + 1σ

The 3D body scans were distributed as follows: 10 (i.e. 15,63%) 3D body scans were grouped into the short height group, 44 (i.e. 68,75%) 3D body scans were grouped into the medium height group, and 10 (i.e. 15,63%) 3D body scans were grouped into the tall height group.

Since the correlation analysis indicated a weak relationship between the horizontal measurements and the vertical measurements, least-squares regression analysis was not used to calculate the vertical measurements for the size specifications. With the vertical measurements grouped into different height groups, the means for each vertical measurement in each height group were then calculated. The vertical measurements were kept constant throughout the size range, i.e. the vertical measurements did not increase with an increase in the horizontal measurements.

RESULTS

Having completed the statistical analysis, the values of the key dimensions, the estimated secondary horizontal dimensions, and the mean vertical measurements of the medium height group were tabulated together to create the size specifications for the body measurements required for a basic sheath dress for young South African women of African descent with a triangular body shape. The size specifications are shown in Table 4.

DISCUSSION

In Table 5, the proposed size specifications and the size specifications currently used in the South African apparel industry were compared, to illustrate the key differences between the

TABLE 4: THE SIZE SPECIFICATIONS

Size specifications (body measurements)						
Size range:	6/30 – 14/38					
Age group:	18 to 25 years					
Garment:	Sleeveless basic sheath dress					
Body shape:	Triangular					
Height group:	Medium					
Population group:	Female students of African descent					
Horizontal measurements	**6/30**	**8/32**	**10/34**	**12/36**	**14/38**	**Grade**
Bust	81,00 cm	85,00 cm	89,00 cm	93,00 cm	97,00 cm	±4,00 cm
Waist	70,08 cm	73,36 cm	76,64 cm	79,92 cm	83,20 cm	±3,28 cm
Hips	96,37 cm	100,42 cm	104,47 cm	108,51 cm	112,56 cm	±4,05 cm
Shoulder	11,05 cm	11,29 cm	11,54 cm	11,78 cm	12,03 cm	±0,25 cm
Across chest	29,05 cm	30,27 cm	31,48 cm	32,69 cm	33,90 cm	±1,21 cm
Across back	31,05 cm	31,77 cm	32,49 cm	33,21 cm	33,93 cm	±0,72 cm
Bust span	17,66 cm	18,01 cm	18,36 cm	18,70 cm	19,05 cm	±0,35 cm
Vertical measurements	**6/30**	**8/32**	**10/34**	**12/36**	**14/38**	**Grade**
Centre front	35,80 cm	35,80 cm	35,80 cm	35,80 cm	35,80 cm	±0,00 cm
Centre back	40,38 cm	40,38 cm	40,38 cm	40,38 cm	40,38 cm	±0,00 cm
Front shoulder height	42,59 cm	42,59 cm	42,59 cm	42,59 cm	42,59 cm	±0,00 cm
Back shoulder height	42,29 cm	42,29 cm	42,29 cm	42,29 cm	42,29 cm	±0,00 cm
Bust-to-waist	17,40 cm	17,40 cm	17,40 cm	17,40 cm	17,40 cm	±0,00 cm
Side seam	23,92 cm	23,92 cm	23,92 cm	23,92 cm	23,92 cm	±0,00 cm
Waist-to-hip	21,26 cm	21,26 cm	21,26 cm	21,26 cm	21,26 cm	±0,00 cm
Waist-to-knee	52,91 cm	52,91 cm	52,91 cm	52,91 cm	52,91 cm	±0,00 cm

TABLE 5: COMPARATIVE SIZE SPECIFICATIONS

Horizontal measurements		6/30	8/32	10/34	12/36	14/38	Grade
Bust	Proposed	81,00 cm	85,00 cm	89,00cm	93,00 cm	97,00 cm	±4,00 cm
	Current	81,00 cm	85,00 cm	89,00 cm	93,00 cm	97,00 cm	±4,00 cm
Waist	Proposed	70,08 cm	73,36 cm	76,64 cm	79,92 cm	83,20 cm	±3,28 cm
	Current	61,00 cm	65,00 cm	69,00 cm	73,00 cm	77,00 cm	±4,00 cm
Hips	Proposed	96,37 cm	100,42 cm	104,47 cm	108,51 cm	112,56 cm	±4,05 cm
	Current	88,00 cm	92,00 cm	96,00 cm	100,00 cm	104,00 cm	±4,00 cm
Shoulder	Proposed	11,05 cm	11,29 cm	11,54 cm	11,78 cm	12,03 cm	±0,25 cm
	Current	12,33 cm	12,67 cm	13,00 cm	13,33 cm	13,67 cm	±0,33 cm
Across chest	Proposed	29,05 cm	30,27 cm	31,48 cm	32,69 cm	33,90 cm	±1,21 cm
	Current	31,33 cm	32,67 cm	34,00 cm	35,33 cm	36,67 cm	±1,33 cm
Across back	Proposed	31,05 cm	31,77 cm	32,49 cm	33,21 cm	33,93 cm	±0,72 cm
	Current	34,33 cm	35,67 cm	37,00 cm	38,33 cm	39,67 cm	±1,33 cm
Bust span	Proposed	17,66 cm	18,01 cm	18,36 cm	18,70 cm	19,05 cm	±0,35 cm
	Current	16,67 cm	17,33 cm	18,00 cm	18,67 cm	19,33 cm	±0,67 cm
Vertical measurements		**6/30**	**8/32**	**10/34**	**12/36**	**14/38**	**Grade**
Centre front	Proposed	35,80 cm	35,80 cm	35,80 cm	35,80 cm	35,80 cm	±0,00 cm
	Current	36,67 cm	37,33 cm	38,00 cm	38,67 cm	39,33 cm	±0,67 cm
Centre back	Proposed	40,38 cm	40,38 cm	40,38 cm	40,38 cm	40,38 cm	±0,00 cm
	Current	40,33 cm	41,17 cm	42,00 cm	42,83 cm	43,67 cm	±0,83 cm
Front shoulder height	Proposed	42,59 cm	42,59 cm	42,59 cm	42,59 cm	42,59 cm	±0,00 cm
	Current	43,00 cm	44,00 cm	45,00 cm	46,00 cm	47,00 cm	±1,00 cm
Back shoulder height	Proposed	42,29 cm	42,29 cm	42,29 cm	42,29 cm	42,29 cm	±0,00 cm
	Current	44,00 cm	45,00 cm	46,00 cm	47,00 cm	48,00 cm	±1,00 cm
Bust-to-waist	Proposed	17,40 cm	17,40 cm	17,40 cm	17,40 cm	17,40 cm	±0,00 cm
	Current	15,83 cm	16,17 cm	16,50 cm	16,83 cm	17,17 cm	±0,33 cm
Side seam	Proposed	23,92 cm	23,92 cm	23,92 cm	23,92 cm	23,92 cm	±0,00 cm
	Current	19,33 cm	19,67 cm	20,00 cm	20,33 cm	20,67 cm	±0,33 cm
Waist-to-hip	Proposed	21,26 cm	21,26 cm	21,26 cm	21,26 cm	21,26 cm	±0,00 cm
	Current	18,67 cm	19,33 cm	20,00 cm	20,67 cm	21,33 cm	±0,67 cm
Waist-to-knee	Proposed	52,91 cm	52,91 cm	52,91 cm	52,91 cm	52,91 cm	±0,00 cm
	Current	51,54 cm	52,54 cm	53,54 cm	54,54 cm	55,54 cm	±1,00 cm

proposed size specifications and the current size specifications.

The bust measurements of the proposed size specifications are equal to the bust measurements of the current size specifications, since the bust measurements of the proposed size specifications are based on those of the current size specifications. In young South African women of African descent with triangular body shapes characterized by a small upper body, the proposed horizontal measurements of the upper body above the bust were consequently found to be smaller than those of the current size specifications, with the exception of the bust span measurement. In Table 5, the shoulder, across chest, and across back measurements of the proposed size specifications are smaller than those of the current size specifications. The smaller estimated grades for the measurements of the upper body above the bust, the findings of this study are in accordance with the findings of other researchers. Previous studies suggest that the grades used in the apparel industry for the measurements of the upper body above the bust tend to be bigger than necessary (Bye *et al*, 2006; Schofield, 2007:189).

With the horizontal lower body measurements of the unit of analysis being larger than those of the current size specifications, the unit of analysis may require a garment sized according to the current size specifications that is larger than a garment sized according to the proposed size specifications. Consequently, with garments sized according to the current size specifications, the unit of analysis may experience loose fit in the upper body of garments sized according to the current size specifications due to the current size specifications being based on the balanced Western ideal body shape.

Within the apparel industry, the bust, waist, and hip girths are assumed to change by the same

amount with change in size (Cooklin, 1990:21). However, according to the size specifications developed in the study, the waist and hip girths do not change by the same amount with change in size. In the proposed size specifications, the estimated grade for the hip girth (4,05 cm) is marginally larger than the grade of the bust girth (4 cm), whereas the estimated grade for the waist girth (3,28 cm) is considerably smaller than the grade of the bust girth (4 cm).

Most of the vertical measurements of the size specifications are slightly shorter than the vertical measurements of the current size specifications. The differences in the vertical measurements may be attributable to the vertical measurements of the proposed size specifications not being graded across the size range. In the proposed size specifications, the vertical measurements were not increased as the horizontal measurements increased, since the findings of the correlation analysis indicated a weak relationship between the horizontal measurements and the vertical measurements. However, in the size specifications currently used in the South African apparel industry the vertical measurements increase as the horizontal measurements increase, despite the findings of previous anthropometric studies suggesting that the vertical measurements do not increase as the horizontal measurements increase (Faust & Carrier, 2010; Gupta & Gangadhar, 2004; Petrova, 2007:67; Schofield & LaBat, 2005). With the increasing of the vertical measurements as the horizontal measurements increase, young South African women of African descent with a triangular body shape may experience poor fit with the current size specifications.

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

In a multi-cultural society such as South Africa, where the populace consists of various ethnic groups with differing body shapes, the findings of the study suggest that current South African sizing based on the Western ideal body shape may not adequately accommodate young South African females of African descent with a triangular body shape. The findings suggest that these females may experience loose fit in the upper body of the garments sized according to the current size specifications.

The findings of the study further indicate the need for a representative anthropometric survey of the South African population. Currently in South Africa, ready-to-wear apparel sizing is based on British anthropometric data published in 1957 (Strydom, 2006:217; Zwane & Magagula, 2007), which does not reflect the shapes and the dimensions of contemporary young South African females of African descent with triangular body shapes.

Differently shaped consumers require differently shaped apparel to accommodate figure variations. Apparel students who aim to enter the retail environment, as well as apparel manufacturers and retailers who would like to target diverse multi-cultural markets, such as the South African market, therefore need to be cognizant of the differences between body shapes and body shape characteristics of different consumer groups.

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