

**BODY MEASUREMENTS FOR USE IN PATTERN AND APPAREL CONSTRUCTION
OF BLACK CHILDREN IN THE NORTH-WEST PROVINCE AGED 10-14 YEARS: A
COMPARISON WITH THE MEASUREMENTS USED BY THE INDUSTRY.**

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DEDICATION

I would like to give my special dedication to:

God Almighty, for His goodness and mercy.

My husband Harry for his support and encouragement.

My children Ripfumelo, Mfanelo and Katekani.

My father, Samuel Mbhenyane and my late mother, Nancy-Grace

Mbhenyane for being good role models.

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SUMMARY

Good fit of clothing is crucial for consumer satisfaction irrespective of age, gender or ethnic group. Up to now little attention was given to the clothing needs of the black consumer in South Africa, despite the fact that the black population group is the biggest and that 60%-70% of all spending is done by them. As a result of historical development, most South African manufacturers and retailers use European measuring charts. It is known, however, that anthropometric measurements, including measurements for pattern design and clothing construction, for one ethnic group cannot automatically be used for other ethnic groups. It is therefore of vital importance that the industry must reconsider and update their sizing charts to cater for this up coming market as well.

The aim of this study was to determine whether significant differences exist between the measurements used by the clothing industry and the body measurements of young black children aged between 10 and 14 years.

The sampling for this project was done in consultation with the Statistic Consultation Service of the North-West University. A list of schools was obtained from the North-West Department of Education. A total of 44 schools in rural as well as urban areas was randomly selected and within each school a sample of each age group was randomly selected. Children from 10, 11, 12, 13 and 14 years old were included in this study. Measurements were taken from a total number of 718 black children of which 293 were boys and 425 girls.

Various girth and length measurements were obtained. Almost 69% of the black boys' measurements in all age groups were smaller than those used by the industry. The black girls' results show that 15% of their body measurements in all age groups were smaller than those used by the industry. Across all the girls' age groups four to five of the measurements (31%-38%) showed a significant statistical as well as practical difference from the measurements of the industry. The neck base measurement for all age groups of the boys and girls was statistically larger than the measurements used by the industry. The shoulder length measurements of all age groups of the boys and girls showed no statistically or practically significant differences from those of the industry.

It is concluded that the measurements used by the industry for each age group do not represent those of the black children aged 10-14 years in the North-West Province.

It is recommended that the industry should take this into account in revising their size charts to ensure a better fit of garments for black children of all age groups.

OPSOMMING

Goeie passing van klere is van kardinale belang vir verbruikerstevredenheid, ongeag ouderdom, geslag of etniese groepering. Tot nou toe is daar in Suid-Afrika min aandag aan die swart verbruiker se klerebehoefte geskenk, ten spyte daarvan dat hulle die grootste bevolkingsgroep uitmaak en 60%-70% van alle besteding deur hulle gedoen word. As gevolg van die historiese ontwikkeling maak die meeste klerefabrieke en klerehandelaars gebruik van Europese mate-tabelle. Dit is egter bekend dat antropometriese mates, insluitend dié vir patroonontwerp en klerekonstruksie, vir een etniese groep nie outomaties vir 'n ander etniese groep geskik is nie. Dit is dus noodsaaklik dat die klere-industrie hulle mate-tabelle moet heroorweeg en opdateer sodat daar ook vir hierdie opkomende mark voorsiening gemaak kan word.

Die doel van hierdie studie was om vas te stel of daar 'n verskil bestaan tussen mates wat deur die industrie gebruik word en die liggaamsmates van jong swart kinders tussen 10 en 14 jaar oud.

Die steekproef vir hierdie projek is in samewerking met die Statistiese Konsultasiediens van die Noordwes-Universiteit getrek. 'n Lys van skole is van die Noordwes Departement van Onderwys verkry. 'n Totaal van 44 skole in plattelandse sowel as stedelike gebiede is ewekansig gekies. In elke skool is 'n steekproef uit elke ouderdomsgroep ewekansig gekies. Kinders van 10, 11, 12, 13, en 14 jaar oud was ingesluit in die studie. Mates van 718 swart kinders, waarvan 293 seuns en 425 dogters was, is geneem.

Verskeie omtrek- en lengtemates is verkry. Ongeveer 69% van die swart seuns van alle ouderdomsgroepe se liggaamsmates was kleiner as die mates wat deur die industrie gebruik word. Die resultate van die swart dogters toon aan dat 15% van hulle mates van alle ouderdomsgroepe kleiner was as die wat deur die industrie gebruik word. In al die ouderdomsgroepe van die dogters was daar vier tot vyf mates (31%-38%) wat statisties sowel as prakties betekenisvol verskil het van die mates van die industrie. Die neklynometrek vir al die ouderdomsgroepe van die seuns en dogters was statisties groter as die maat wat deur die industrie gebruik word. Die skouerlengtemaat van al die ouderdomsgroepe van die seuns en dogters het nie statisties of prakties beduidend van die

mates wat deur die industrie gebruik word, verskil nie.

Daar is tot die gevolgtrekking gekom dat die mates wat die industrie vir die verskillende ouderdomsgroepe gebruik nie verteenwoordigend van dié van swart kinders in die ouderdomsgroep 10-14 jaar in die Noordwes Provinsie is nie.

Daar word aanbeveel dat die industrie dit in berekening moet bring wanneer hulle hul mate-tabelle hersien om te verseker dat daar 'n beter passing van klere vir alle ouderdomsgroepe van swart kinders sal wees.

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CHAPTER ONE

1 INTRODUCTION

1.1 MOTIVATION AND BACKGROUND FOR THE STUDY

Clothing consumers, especially parents of growing children world-wide, have become more sophisticated shoppers and demand both value for money and fulfillment of needs such as good clothing fit. Farmer and Gotwals (1982:6) cite that all family members, of whatever age or sex, require good fit in clothing. Men and women, boys and girls require clothing that allows them to function in their roles. According to these authors, roles involving extensive physical activity require fit for comfort and ease of movement. They mention that professional roles often suggest more conservative fit in clothing.

In the theatre, costume designers use fit as a means of projecting character images, also taking note of what people usually associate with fit in clothing. It is said that the "poverty" look is associated with oversized, baggy clothes. The sexy look is portrayed by tight, body-accentuating clothing. Customisation is probably the answer to good fit, but for most people, especially in South Africa, it is too sophisticated and expensive (Farmer & Gotwals, 1982:7).

Manufacturers and retailers aim to produce apparel that consistently fits their target market, because apparel that fits well increases customer satisfaction and sales. Another challenge for manufacturers and retailers is to provide garments that continue to fit after wear and care (Brown & Rice, 1998:140).

The subjects for this study are young adolescents of 10-14 years old in the North-West Province of South Africa. During adolescence unique physical body changes occur and many adult features are established. There are many genetic and environmental factors that influence the physical development of a child. Any disturbance in the normal development and growth may lead to disproportion of physical features. Most features, however, display more or less recognisable patterns of growth and development (Hall et al., 1989:9). Growth is defined as the

essence of the developing organism. Physical growth starts shortly after fertilisation and continues throughout pregnancy, childhood, and adolescence. Growth of different parts of the body follows a predictable schedule during normal development and maturation (Hall et al., 1989:8).

The rapid changes during adolescence include increases in body dimensions, i.e. growth and progressive attainment of adult status (WHO, 1995:263). To a significant extent, the variation in adolescent body size and the timing of the maturational event is determined by normal genetic inheritance in populations whose environment allows expression of genotype. Variation in adolescent growth may also reflect environmental influences that were active earlier in life. Consequently, it is difficult in many particular situations to determine the degree to which the observed levels of adolescent growth result from purely environmental effects. Obviously, a wide range of abnormal clinical syndromes with specific genetic etiologies may also affect adolescent growth (WHO, 1995:268). These changes in adolescent growth also affect their body sizes, which have a significant influence on determining appropriate clothing sizes for this age group.

Adolescent anthropometry varies significantly world-wide. Many of the differences observed according to chronological age categories are attributable to variation in maturational timing, and diminish when the timing of adolescent spurt is considered. It is clear, however, that growth differences among population groups are related to nutritional status, socio-economic levels, and degree of industrialisation, urbanisation and altitude of residence. Individual adolescent growth may also be limited by such factors as prolonged under-nutrition, infection and chronic disease (WHO, 1995:268).

Because body sizes and proportions of people of different population groups may differ significantly and as body shapes vary not only from country to country but also within countries, it is not feasible to construct a single set of body sizes which could be universally applied.

South Africa has a heterogeneous population comprising 77.8 % blacks, 10.5 %

Whites, 8.9 % Coloureds and 2.6 % Indians (Statistics SA, 2002:50). It is said that 60 – 70 % of all spending is done by blacks, but their clothing needs have received little or no attention (Padayachee, 2003:5)

1.2 PROBLEM STATEMENT

Unsatisfactory sizing is a source of much consumer difficulty in the selection of suitable clothing for children (Padayachee, 2003:5). South African clothing industries do not base their sizing on any relevant research (Moritz, 2000:40). Apparently many of the size charts used by the industry have been based on measurements that were printed in pattern construction books, dating back to 1950. These were also based on European body measurements, which are quite different to those of our average South African body measurements (Moritz, 2000:40). Black South Africans have been struggling to find clothes that fit their children properly (Padayachee, 2003:5).

To support the problem statement of this research, Padayachee (2003:5) reported an investigation into a new sizing system for children's clothes, involving a three-year study conducted by major clothing chains stores and the universities of Stellenbosch and Potchefstroom.

1.3 AIM OF STUDY

The aim of this study, which is part of the larger multi-disciplinary THUSA BANA project described in paragraph 3.1, is to analyse the variations in body dimensions of black adolescent boys and girls, in order to determine the most satisfactory basis for the sizing of this group's garments and patterns, and to determine whether significant differences exist between the measurements used by the clothing industries and the body measurements of black adolescent children of ages between 10 and 14 years.

1.4 OBJECTIVES

The main objectives for the study are:

- ♦ To obtain the sizing charts used by the clothing industry in South Africa,

- ♦ To take the relevant body measurements of black children in age groups 10,11,12,13 and 14 years in the North-West Province of South Africa.
- ♦ To compare the measurements of the black adolescent children of the North-West Province and those used by the industry statistically and determine differences between these two sets of measurements, in order to investigate the probability of consumer satisfaction with clothing fit and make recommendations to manufacturers and retailers.

1.5 RESEARCH FRAMEWORK

The structure of the research is summarized in the following framework.

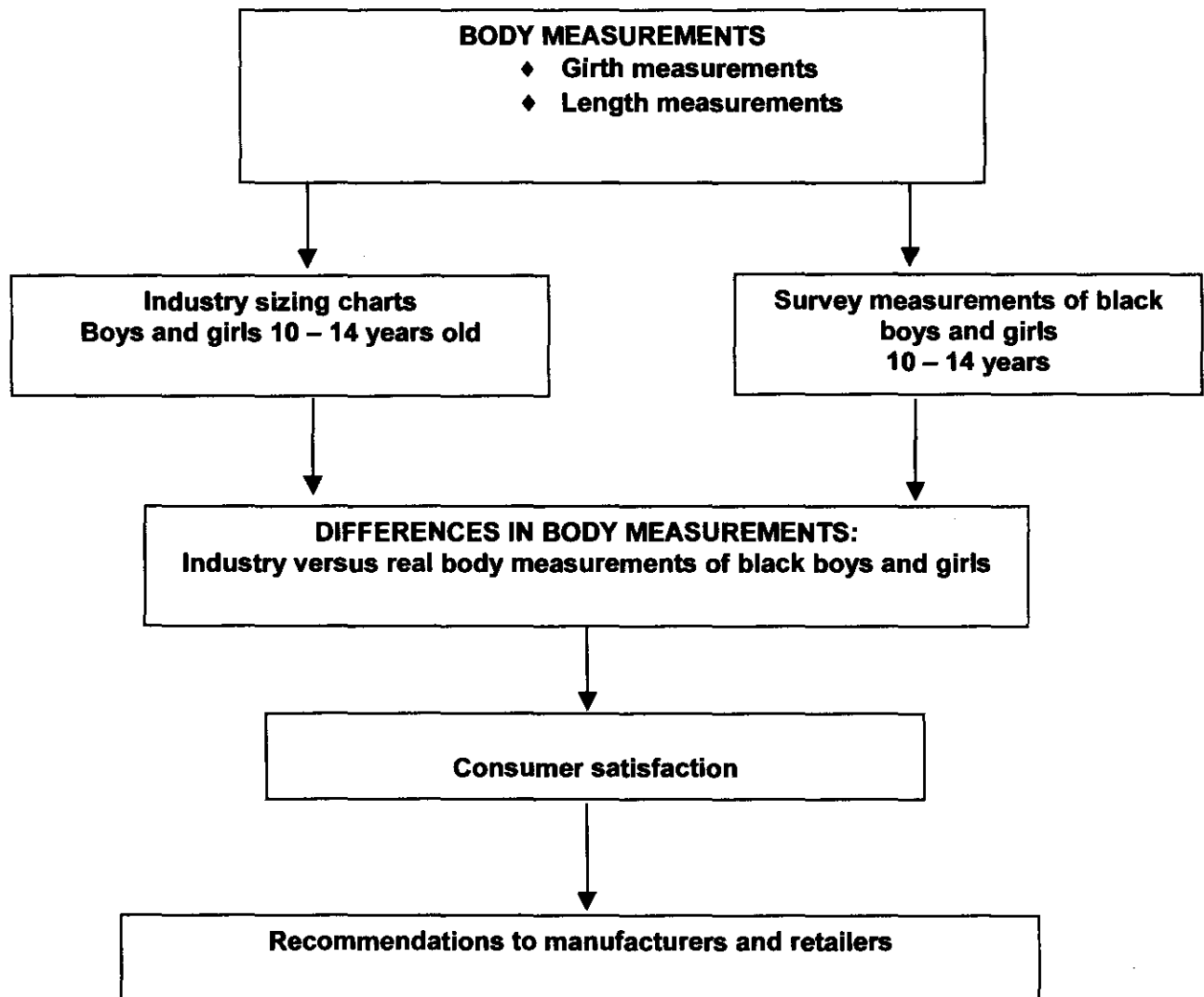


Figure 1: Research framework

1.6 HYPOTHESIS

There is a significant difference between the existing measurements used by the clothing industries and the body measurements or sizes of black adolescent children of ages between 10 and 14 years in the North-West Province of South Africa.

1.7 DEFINITIONS

- 1.7.1. Body measurements are measurements taken of the human body and are essential when constructing a pattern and garment in order to ensure a pleasing fit (Blignault et al., 1987:377).
- 1.7.2. Anthropometry is defined as a science concerned with the measurements of man (Beazley, 1997:56).
- 1.7.3. Growth is the essence of the developing organism; growth of different parts of the body follows a predictable schedule during normal development and maturation (Hall et al., 1989:8).
- 1.7.4. Adolescence is a significant period of human growth and maturation. Unique changes occur during this period and many adult patterns are established (WHO, 1995:263).
- 1.7.5. Apparel is another word for clothes and these terms will be used interchangeably in the study.
- 1.7.6 Control dimensions are the dimensions of the body given on labels to enable consumers to buy clothes that fit, e.g. height for children's clothes (Aldrich, 1999:14).
- 1.7.7 Key dimensions are good predictors of measurements of other body parts but must be convenient to measure, correspond to integral parts of the garment, have a high degree of correlation with other dimensions important in design and sizing, and not be highly correlated with one another, e.g. vertical measurements: height; horizontal measurements: weight, bust, girth, hip girth and waist girth (Workman & Lenz, 2000:252).

1.8 STRUCTURING OF THE DISSERTATION

The dissertation is arranged in the order listed below.

Chapter 1: Introduction. This chapter includes the theoretical point of departure, the motivation for the study, the problem statement, the objectives, as well as the definitions of key concepts.

Chapter 2: Literature review. This chapter includes two main sections, namely Fitting and sizing and Anthropometry.

Chapter 3: Methodology. This chapter deals with the description of methodology and data gathering from the population of interest.

Chapter 4: Results and discussion. This chapter focuses on the analysis and discussion of the results obtained from the empirical study.

Chapter 5: Conclusions and recommendations. Conclusions and implications of the study are discussed, and recommendations for future studies are proposed.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 gave an introductory perspective on the research. The research framework derived from the motivation and background of the literature will serve as the foundation for the literature review. The review will focus on fitting and sizing, and on anthropometry.

2.2 FITTING AND SIZING

To improve body satisfaction of body image, clothing needs to fit the body properly. Fit satisfaction is the extent to which the consumer is satisfied with the selection of ready-to-wear clothes in his/her size (Feather et al., 1996:23). It was noted that many individuals do not fit the standard sizes produced by the apparel industry and consumers vary as to what constitutes good fit. Some individuals prefer garments that conform loosely to the body whereas others prefer those which conform closely to the body (Feather et al., 1996:23).

Sizing is a complex issue because it deals with a great amount of variability, fluctuating body dimensions between individuals, populations and generations, differences in collecting and processing anthropometric data, and variations in analyzing and interpreting them into sizing systems. Fit testing deals with an even greater amount of variability (Le Pechoux & Ghosh, 2002:39).

2.2.1 Fitting problems

Traditional methods of taking body measurements to be used in the clothing industry have resulted in several major problems, apart from being complex and difficult to learn. The most important problem is that of poor fit, which leads to returned goods and consumers' dissatisfaction (Conner, 1995:19).

Lack of a really good picture of a target population means that manufacturers must produce and retailers must buy far more stock than would be otherwise necessary,

including odd-sized garments which will not be sold, thereby reducing margins. Attempts by manufacturers and shops to limit their overheads by carrying restricted size ranges has resulted in many customers, particularly those needing a larger fitting, not being catered for (Tait, 1998:24).

To be able to offer better fitting garments to a wide variety of people, one need not only look at the size of the body, but also the shape, a point clearly made during a conference by Graham Hutton from Computer Clothing Research (Tait, 1998:24). Clothing is associated with body satisfaction. Feather et al. (1997:125) mention that clothing has the potential to improve an individual's body satisfaction, because females evaluate their body higher when clothed than when unclothed. Good fit of clothing is vital to an individual's psychological and social well-being.

Because of the outdated and inadequate nature of some national databases like that of the US Department of Agriculture, many apparel manufacturers have been developing their own version of the sizing system, using their own criteria. Most individual company charts of body measurements and proportions focus on a sample of a very specific market segment which they think is representative of their market (Workman, 1991:32).

Goldsberry et al. (1995:109) cite that in addition to assisting retailers in reducing floor inventories in recent years, manufacturers have offered fewer figure type categories and more apparel sized as just small, medium and large. When the base measurements are inconsistent among manufacturers for a given figure type, proportion and size, or when hang tag numbers vary for the same body proportions in the name of flattering the consumer, the consumer becomes more confused and frustrated.

Tailor (1990:49) notes that when designing a size chart, it is always advisable to base it on close fitting clothing, which means placing the sizes as close together as possible. This will lend itself to all degrees of fit, as two sizes can be coupled together to indicate the range of body sizes that a garment will be suitable for.

There should be a minimum increment that can be safely put between sizes. This should not be less than the tolerance added to the body measurement for movement and comfort on the major girth that is indicated on a sizing ticket. The tolerance added can also differ between manufacturers. They use the same body measurements but add differently and the fit is different (Tailor, 1990:49).

It should be taken into consideration that young children's bodies are not proportioned like those of adults. Pattern makers must recognize the differences in order to produce children's wear that fits properly. Children's wear is frequently cut in incorrect proportions for the child it is intended to fit; the arms and legs are cut in proportions that look right to adults when compared to the size of the garment, rather than in proportion to the body of the child. Consumers purchase such garments because they have proportions that look like clothing for miniature adults (Brown & Rice, 1998:152).

However, even an anthropometric labelling system would not eliminate the need to try on clothing because consumers have varied preferences in fit. Ashdown and De Long (1995:50) investigated the smallest difference in fit that could be perceived by individuals. They found that individuals varied in tolerance for fit variations at different locations on the body.

South Africa has many different ethnic groups, which have differences in children's body shapes. These ethnic body differences are more marked than differences between middle-class and poor children, or between rural and urban children (Padayachee, 2003:5). These differences in body shape leads to the difficulties in finding clothes that fit the South African children properly. This difficulty may be due to the fact that size charts which are being used for children's clothing are still based on European body measurements and are different from the average South African body measurements (Moritz, 2000:40).

2.2.2 Sizing of children's clothes

Successful manufacturers and retailers spend a great deal of time and effort perfecting the sizing and desired fit for the target market customers. They conduct marketing studies to learn not only the buying habits of the target customers but their

approximate sizes, shapes and fit preferences. They use this data to design garments that suit the sizing and fit needs of the target customer (Brown & Rice, 1998:131).

Sizing systems related to real body measurements simplify the task of comparing and compiling information from various sources. Adopting such systems requires a long-term process of educating the consumers as well as the retailers in body dimensions and how to measure them correctly (Le Pechoux & Ghosh, 2002:39).

Although age may not be an appropriate criterion for sizing children's clothing, it is a useful medium for categorisation of data from the key dimensions. The procedure of sorting out data according to age, enables the researchers to analyse each key dimension in age bands of two, three, four, five and six years (Aldrich, 1999:14). On using age as a key dimension, James and Stone (1984:64) suggest that, since customers will probably know the age of the child even if they are not close relatives, buying will be easy and satisfactory, and chubby children would be able to wear clothes for older children.

However, the following disadvantages would prevail in case of sizing based on age:

- ♦ Clothes may not fit well, especially if bought by someone who does not know the child's size. For the retailer this would mean high levels of exchange, returns and soilage as well as decreased customer satisfaction.
- ♦ The child who has to wear clothes labelled for younger or older children may be embarrassed (Otieno & Fairhurst, 2000:150).

Chun-Yoon and Jasper (1995:2) note the fact that children and babies are the most difficult regarding sizing because of the growth factor and the large number of sizes that must be offered.

2.2.3 Size labelling

Ever since garments were first mass produced more than 100 years ago, manufacturers have needed to know what sizes to make and how to size label the garments. As a consequence, a variety of sizes and labelling systems have

developed over the years in manufacturing centres over the world (Winks, 1988:7). A size label, according to Chun-Yoon and Jasper (1996b: 431), is a tool for assisting consumers in choosing apparel that properly fits their body. They further mention that a common consumer complaint involves inability to choose the appropriate size garment by reading the garment label.

Aldrich (1999:14) notes that the size designation on a label should have the control dimensions in centimetres of the intended wearer of the garment and that garment measurements are not included in the size designation. However, where they are considered to be of value they can be added as additional information and indicated separately.

Smirfitt (1997:19) notes that in most countries labels for children's clothing refer to the dimensions of the person the garment is expected to fit, but in Canada size sometimes is referred to as the actual garment measurements. It is also noted that most countries accept that children's sizing be height-based, but for other garments there are differences of opinion as of what should be used as control dimensions and what should be regarded as of secondary importance (Smirfitt, 1997:19).

"Overall, the outstanding benefit of an anthropometric size-labelling system that includes key dimensions would be to facilitate communication between manufacturers, retailers and consumers" (Brown & Rice, 1998:133). A suggested method for implementing such a system would be to incorporate pictograms with key body dimensions on garment labels. Other benefits of an anthropometric size-labelling system are:

- Body measurements related to key dimensions included on an anthropometric size label would let consumers know the garment size before trying on the garment.
- Such a system would lower returns of mail-order purchases and damage caused by repeated fitting of retail garments.
- For imported or exported merchandise, if garments' size labels included pictograms with body measurements that illustrate key dimensions,

consumers could purchase garments that would fit even if they could not decipher the language and sizing system (Chun-Yoon & Jasper, 1996a: 94).

A size label is designed to provide information that will allow customers to select the correct size efficiently. If the size designation does not represent the same body dimensions from one label to the next, consumers are more likely to be frustrated and unhappy. It was found that size labels of women's garments have inadequate information to guide consumers in initial selection of the correct size (Workman & Lentz, 2000: 252; Chun-Yoon & Jasper, 1995:2).

2.2.3.1 Pictograms

In pictograms the body measurements critical to the fit of the particular garment are indicated on a sketch of the human body (Brown & Rice, 1998:133). Brown and Rice, (1998:133) confirm that pictograms overcome language barriers and are easy for consumers to understand. At a glance, they give the shopper an idea of whether or not a garment will fit, if the shopper knows his or her own measurements. An increase in the use of pictograms for international trade should be expected; they are a practical solution to the size labelling of garments for import and export. They provide meaningful information about size because they are based on body measurements. Some mail-order retailers use pictograms to communicate size or measuring information to consumers in catalogues.

2.2.3.2 Numbered sizing

Brown and Rice (1998:132) refer to numbered sizing as the most common method of sizing the majority of mass-produced clothing. They mention that most of the children's clothing sizes are stated in numbers that correlate to a set of body measurements. Various sizing systems involving numerical sizing were compared. In the US they use numbers from size 6, 8, 10, 12, 14, 16, 18 and 20. Continental sizing involves the use of numbers such as 34, 36, 38, 40, 42, 44 and 48 (Brown & Rice, 1998:133). These numbers do not correlate with the body measurements of the consumers, which is the cause of much confusion in the market place (Brown & Rice, 1998:133; Winks, 1988:7).

Apart from the variable size labelling, sizing systems themselves have been based on different parameters and have used different size numbers and different size intervals between sizes (Winks, 1988:7).

2.2.3.3 Lettered sizing

One method of sizing involves lettering such as small (S), medium (M), large (L), and extra large (XL). This system is used without any differentiation for unisex garments in children's wear. This is common for garments such as sweaters, knit shirts, sleepwear, and underwear, and for all types of garments in low price lines (Brown & Rice, 1998:134).

2.2.3.4 Key dimensions

Key dimensions are said to be the dimensions of the body given on labels to enable consumers to buy clothes that fit (Aldrich, 1999:14). She mentions that the size dimension on a label should have the key dimensions in centimetres of the intended wearer of the garment and that age alone is an unreliable guide to fit, as children's stature in relation to age is very variable. The different measurement increments between the sizes in the charts based on age resulted from the uneven growth and body shape changes. A key dimension must satisfy two criteria: First, to provide the framework from which size categories ultimately will be generated. A key dimension must be a good predictor of body dimensions related to a certain garment type. Second, to assist consumers in determining their own garment sizes. A key dimension must be one that can be measured accurately by consumers. Key dimensions for specific garments may be determined by a compromise between the two criteria (Chun-Yoon & Jasper, 1996a: 94).

According to Aldrich (1999:14) the basic key measurement of all children's clothing is height. Some manufacturers have accepted the move to designate size by the height dimensions and they are using this system for children up to eleven. The size designation is based on the body and not on garment dimensions.

Choice of garment measurement is normally left to the designer and the manufacturer who are concerned with style, cut and other fashion elements and

must also make allowances for garments normally worn beneath a specific garment (Aldrich, 1999:14).

Key dimensions are good predictors of measurements of other body parts but must be convenient to measure, correspond to integral parts of the garment, have a high degree of correlation with other dimensions important in design and sizing, and not be highly correlated with one another (Workman & Lentz, 2000:252).

2.2.4 Size classification for boys and girls

Girls' sizes based on age fit approximately 7 to 11 years olds. The bust line is undefined and the waistline slightly delineated. The voluntary apparel sizing standards in the US provide a range from age 7 to 18, although many retailers carry only 7 to 14. Girls' sizes correlate with height, chest, waist and hip measurements in the voluntary standards. The standards also suggest the body-build categories of slim, regular and chubby. Manufacturers and retailers usually choose more appealing terms than chubby, for example, pretty-plus and size-up (Brown & Rice, 1998:135).

Brown and Rice (1998:135) further mention that some retailers carry an additional size classification, not included in the voluntary standards. They call this classification preteen, teen, junior-high or young juniors. It is designed for girls with a more defined waistline who are not yet ready for junior sizes. These sizes typically run from 6 years to 14 years.

Boys' sizes fit boys approximately from 7 years to 17 years old. The boys' figures are characterised by developing shoulders and a delineated waistline. The voluntary apparel sizing standards provide a range from 2 to 24, although many retailers carry only the even-numbered sizes from 8 to 20 years (Brown & Rice, 1998:135). The voluntary standards correlate boys' sizes to height, weight, chest and waist measurements and it also suggests the body-build categories slim, regular and husky. Some retailers offer boys' sizes 8 to 14 and an additional size classification for sizes 16 to 20, which is not included in the voluntary apparel sizing standards. This size classification is called prep, student teen, or cadet to appeal to bigger boys not yet ready for young men's sizes (Brown & Rice, 1998:136).

2.2.5 Size charts for unisex clothes

There has been a strong movement towards separating boys and girls wear. Children's clothing up to the age of seven or eight is largely bisexual regarding size and shape. It is also noted that manufacturers in leisure and jersey wear are still producing unisex clothes for boys and girls. Therefore it is necessary to develop separate charts and model standards for older children. These size charts with the reduced size ranges should also be retained. It should be considered, however, that if a reduced size chart specifically for boys and girls is required, measurements from alternative sizes in the main size chart could be used and also that height intervals in the unisex chart provide a guide for the labelling (Aldrich, 1999:5; Tailor, 1990:50).

2.3 ANTHROPOMETRY

The first individual to mark the beginning of statistical anthropometry was Quelet in 1870, who desired to obtain measurements of the average man (Simmons & Istook, 2003:307). It was not until the 1950's that anthropometrics became a recognized discipline.

Anthropometry is seen as the study of comparative measurements of the human body (Hall et al., 1989:18). It is the practice of measuring the human body. Both the designer in clothing and ergonomist in clothing have a continuing need for up-to-date anthropometric data to model equipment, working situations and clothing for optimal use (Croney, 1980:51).

According to Kroemer et al. (1986:1) anthropometry describes the dimensions of the human body. Anthropometry is also seen as the measurement of certain parameters of the human body (Woodruff, 2000:2). In Beazley (1997:56) anthropometry is defined as a science concerned with the measurement of man. Beazley (1997:56) also notes that this procedure could be divided into two types: First, static anthropometry or structural anthropometry, which is the measuring of the dimensions of a human being. Static anthropometric data is generally required and used for pattern designing in clothing manufacturing for the mass market. Secondly, dynamic anthropometry or functional anthropometry, which is the measuring of the

stretch and movement of a human being. Fitting problems call for anthropometric surveys to be done in clothing.

2.3.1 Anthropometric measurement techniques

There are several methods of collecting anthropometric data. In this study only three methods will be discussed briefly: The direct method, the photographic method and scanning.

2.3.1.1 The direct method

The direct method, which is also called the tape measure method, was used for this survey. The direct method will be discussed in the methodology (Chapter 3).

2.3.1.2 The photographic method

This method was introduced in the early nineties as a first step towards non- contact body measurements (Le Pechoux & Ghosh, 2002:13). The subject's body image is initially captured on video in this method. Then, black and white photos are developed. Finally, calipers are used to measure lengths, widths and depths on the photographs. This low-cost, non-intrusive, automated process of data collection offers computerised analysis of visual data to measure silhouette angles and diameters (Le Pechoux & Ghosh, 2002:13).

It was found that photographic measurements predict the planer dimensions as well as the linear measurements, with the added advantage of accurately predicting pattern angles for shape and curve variations when compared with the traditional manual method (Le Pechoux & Ghosh, 2002:13).

2.3.1.3 Scanning

According to predictions of some experts (Conner, 1995:20), it is possible that within the next decade, taking body measurements will not be necessary, it will be possible for a consumer to enter a shop, be scanned and then see exactly how any garment in the shop would appear on him. It is even possible that the garment could be ordered by the shop, tailor-made to fit (Conner, 1995:20). Personalised clothing made to fit the individual and delivered within days is seen by some as a potential

saviour for manufacturing in the developed world. However, before this concept takes off, it requires a reliable and precise body measuring system. The body scanning system is recommended for this purpose (Nuki, 1999:16).

Scanning is a computerized system used to measure the human body quickly and accurately so as to build up a detailed computer model from which garments can be designed (Nuki, 1999:16). The computer system uses SYMCAD (Systems for measuring and creating anthropometric databases) to achieve perfectly fitting clothes (Conner, 1995:19).

For this system, the person whose body is to be modelled stands wearing his/her underwear in a booth roughly the same size as a store changing cubicle, which contains an imaging system. The operator then asks the subject to present his/her front and profile views to the camera, a process that takes about 30 seconds. The images are then processed and the computer will release a list of pre-defined measurements and anthropometric data. This information forms a three-dimensional model of the body. The system presents an exact image on the screen, including details of posture (Conner, 1995:19).

Scanning has its advantages and disadvantages. The good points of scanning include the following: It details an individual's shape as well as size. A tape measure may tell you nothing about where on his/her hips the bulk of these centimetres lies, while with scanning one can see exactly what the situation is (Nuki, 1999:16).

Another good point is that the operator can take exact measurements at any point on the body without the person being present and feed these into a data file. This is done to build up a sample of a target population, provide statistical analyses and automatically create size charts adapted to the population to be dressed (Conner, 1995:19).

Among other advantages, scanning also offers rapid responses, reduced overhead costs, better fitting garments, and an opportunity for manufacturers and retailers to learn more about their consumers (Mckinnon & Istook, 2002:104). Scanning has

also eliminated the greatest hindrances to anthropometric surveys, which are time and data reproducibility (Mckinnon & Istook, 2002:104).

The disadvantages of scanning include the following: It is an expensive method of taking measurements for anthropometric data and it has been found that apparel jobs diminish due to textile clothing technology (Nuki, 1999:16). Another disadvantage of scanning is that an error may be introduced to the data through the lack of standardisation that currently exists in the scanning process. Inhalation and exhalation are known factors that affect critical measurements. Also, the body captures only body measurements, whereas much fit is determined by garment measurements or tolerances allowed (Workman & Lentz, 2000:254).

2.3.2 Uses of anthropometry

Dynamic anthropometric data is required for the design of home furniture and fitting in all forms of travel and in a wide range of industrial, engineering, educational and medical activities. It is also required in the design of very specialized clothing, which may also be protective or insulating (Croney, 1980:51). Static and dynamic anthropometric data will provide the designer with an armature of dimensions around which ideas can grow (Croney, 1980:51).

Anthropometry has also been used to study the growth and development of school aged children as well as adolescents. In Europe, anthropometric surveys have been used in collecting useful data for such purposes as attaining precision of size and fit in garments for men, women, and children (Otieno & Fairhurst, 2000:143).

Anthropometry is also a standard technique used to assess the nutritional status of humans. It is used to determine the prevalence of under nutrition in a population. It is also used in clinical practice to assess changes in body weight and estimated fat mass (Woodruff, 2000:2).

2.3.3 Various disciplines involved in anthropometric studies

Anthropometric studies are conducted by various disciplines, viz, the society of automotive engineers, the air force and partners from a variety of industries

including the apparel manufacturing and retailing industries (Workman & Lentz, 200:251).

Entrepreneurs are also involved in compiling anthropometric databases. The sport discipline uses profiles of players to describe any morphological differences that exist between selected anthropometric parameters and performances. The analysis of anthropometry has shown that optimum performance appears to have definite physical requirements (Tanner, 1955:41). Anthropometry has been used for years in national sizing surveys as an indicator of health status. Other disciplines like Biokinetics, Nutrition and Consumer Sciences are also involved in using anthropometry.

2.3.4 Figure typing

Genetic and environmental effects continuously influence the growth of human beings. Somatotype studies can be used to reveal the physical changes of the human body. Somatotype study refers to the description and assessment of the body, according to three shapes. It focuses on the biological shape or body configuration of human beings (Tsang et al., 1998:187). The three aspects or components of bodily morphology are called endomorphy, mesomorphy and ectomorphy. The three descriptions were derived from the terms used to describe the three initial layers of the early embryonic forms in higher life. These three were also reasoned to be three aspects or components of the total morphological structure of any individual (Croney, 1980:38).

2.3.4.1 Endomorphy

As a component, endomorphy describes the predominance superficially of fat, giving a roundness and fullness of shape. In deep morphology, it indicates a large digestive system. With a round head and weak appendages the endomorph retains something of infantile appearance (Croney, 1980:38).

(a) Endomorphy male and female

The total physique of the endomorphic male and female is round and soft with large fat storage, and in extreme form, pear shaped. The abdomen is full and extensive and the thorax appears small. The limbs appear short and ineffective.

Shoulders are full and round, supporting a rounded head. The skin is soft and smooth, with fine hair which is showing on the body (Croney, 1980:39).

The side view of the vertebral column of the endomorphic skeleton appears straightened in the thoracic region. Bony girdles of the trunk and pelvis are near the circular. All the bones are small with tuberosities and projection rather rounded (Croney, 1980:39).

The head and trunk of the endomorphic male and female feature small and unobtrusive. They also feature a small cranium in relation to wide palate and face and a short neck. The trunk is long and heavy at the base. The greatest body breadth is near the waist, which is difficult to determine. The thorax is said to be wide at the base. The whole trunk and head has a forward pushing, penguin-like appearance (Croney, 1980:40).

The limbs of the endomorphic skeleton are short and they rapidly taper down to small and weak distal extremities. There is no angularity in the male, and where there can be the appearance of breasts, there is a suggestion of femininity (Croney, 1980:40).

2.3.4.2 Mesomorphy

As a component, mesomorphy describes the predominance of muscle and bone, giving an angular shape. In the morphology it generally indicates a strong, bony frame and connective tissue. With little subcutaneous fat and resolute stance, the mesomorph is very much the ideal male (Croney, 1980:38).

(a) Mesomorphy male and female

The physical appearance of the mesomorphic male and female is square and rigorous with much prominent muscle. The shoulders predominate, with the thorax wide at the apex, and the abdomen small. The limbs appear large and strong. The neck is strong with a rugged head. The skin is rather coarse, as is the hair. All the curves of the vertebral column of the mesomorphic skeleton are

prominent. Bony girdles of trunk and pelvis are wider laterally than in the antero-posterior dimensions. All the bones are heavy, with all the tuberosities and ridges clear. The face is large compared with the cranium. The forehead is often shallow and angular. The neck is long and the sterno-mastoid triangle well marked. The thorax is massive, and in a man, markedly broader than the pelvis. The waist is low with the abdomen almost perpendicular in profile (Croney, 1980:40).

The arms and legs of a mesomorph are generally heavy and well muscled, particularly at their proximal ends. The hands and feet are also large and capable in appearance. Often the forearm and calf muscles are very prominent (Croney, 1980:41).

2.3.4.3 Ectomorphy

As a component, ectomorphy describes a predominance of skin surface relative to body mass. Ectomorphy in extreme, exhibit long, thin body segments, giving a weak and poorly balanced posture. In deep morphology it indicates a large central nervous system and brain. The thin appendicular skeleton, by contrast, makes the trunk too small and the head too large, and there is a consequent suggestion of immaturity in this body shape (Croney, 1980:38).

(a) Ectomorphy male and female

The total physique of the ectomorphic male and female appears to be fragile and slender with a minimum of either fat or muscle. The trunk generally appears short and poorly positioned and is accompanied by long, spindly limbs. Shoulders are wide but droop, the neck is slender and can appear inadequate for the head which often has a large cranium. The skin is thin, hair is brittle and very variable in amount (Croney, 1980:43).

In the vertebral column of the ectomorphic skeleton, the cervical and thoracic curves are well marked to the point of distortion whilst the lumbar curve is flattened. The sub-coastal angle is acute although the thorax is shallow in antero-posterior dimension, particularly in the region of the sternum bone.

Bones are light, but also variable in length, for stature in this component has a wide range (Croney, 1980: 43).

Features of the head and trunk are finely etched, with a slight chin. The brow can be large, the cranium and brain very extensive. The thyroid gland is prominent, and the neck hangs forward from rounded shoulders. The trunk is shallow and flat, the abdomen protruding in front of the thorax in profile. The distinct sag forward of the abdomen is due to ineffective musculature (Croney, 1980:43).

The arms and legs of the ectomorph appear weak and long with a slight musculature. Their weakness is more noticeable at the proximal ends, and the toes and fingers are long and delicate (Croney, 1980:43).

2.3.4.4 Implications of figure typing for children

Designers of children's clothes should be aware of the way a child's body shape changes as it grows and they should be able to recognize the shape of a child at a particular stage. Well-designed children's clothes take account of the child's continually changing shape. It should be taken into consideration that children of the same height can have variable arm and leg measurements and these differences become more apparent between boys and girls as the limb length increases (Aldrich, 1999:6). As a solution to these differences, size charts should be constructed and divided in accordance with the way a child's body generally develops.

In the past, for modeling purposes, virtually all anthropomorphic models have assumed that the human body is rigid, possessing clearly defined segmental boundaries. It is a known fact that exo-and endomorphologies of body segments change as a result of external and internal forces (Mckinnon & Istook, 2002:106).

2.3.5 Variables that affect anthropometric body measurements

2.3.5.1 Gender

It should be noted that boys are often thinner than girls of the same age. The most

significant difference occurs on the hip measurement and some manufacturers of boys wear take account of this. Although the speed at which boys and girls grow is similar until puberty, the average girl is slightly shorter than the average boy and slightly heavier. The average boy starts his growth spurt at about the age of thirteen and grows rapidly until the age of fifteen. The average girl begins to grow quickly at about the age of eleven or twelve and the girl's growth spurt is shorter in duration than that of boys. Age, therefore is of little relevance for size charts at this stage (Aldrich, 1999:8). Adults of the same sex, present a wide variety of shapes and features depending on their ethnic and racial background (Le Pechoux & Ghosh, 2002:3).

2.3.5.2 Nutrition

A definite increase of nutrients will not always produce a definite amount of body tissue. Genetic and environmental factors may combine and inject a series of unknowns into the growth rates of children from the same population, equally well nourished or not (Croney, 1980:31). A newspaper reported that South African middle class children are getting fatter and that overweight children tend to reach puberty earlier because of better nutrition. Children of South Africans who move up the class ladder and earn higher incomes are said to be taller, as they are better provided with better and healthier foods (Padayachee, 2003:5).

2.3.5.3 Growth, development and age

Aldrich (1999:6) notes that a proportion of eleven to thirteen year old girls is taller than boys of the same age. Girls continue to get fatter during their growth spurt, but this is in the trunk rather than the limbs and girls' hip size shows a particular increase. The bust development of a girl is the most dramatic change in her shape. The age at which these different development stages of maturity are reached can differ widely, which means that children between ten and fourteen of similar height and weight can have different bust measurements. Girls who have developing figures require a specific size chart and a pattern block, as children's pattern blocks are inadequate. Aldrich finds that the most difficult market is the subteen group by saying: "Girls at this age are very fashion conscious, yet their figures may not have developed sufficiently to wear adult clothes" (Aldrich, 1999:6).

The child's body is said to be continually changing its shape and therefore its proportions. So it can be said that the child's body is liable and prone to change, and that these changes are normal and build up, stage by stage, towards a balanced mature condition. The variation of the speed of growth between one body part and another is regulated, so that each part reaches its size proportional to the role it has to play in the body's physiology at the correct time (Croney, 1980:31).

It is the alternation of the speed of growth between body parts that leads to a diversification and differentiation of one part of body structure from another. So it may be considered that the human body changes in three ways during development and growth:

- (1) increase in length
- (2) increase in area, and
- (3) increase in weight (Croney, 1980:31).

Croney (1980:31) notes that great variability in children's growth rates could be found. According to him identical children, other than identical twins, do not exist. Average body measurements for children cannot be characterised by a mean value obtained against age. Numerical age has no great significance when determining children's sizes for design purposes. The two variables needed are body dimensions and velocities of growth. A series of measures of one particular body dimension from a child, taken over a period of years, would show incremental increase by which the velocity of growth of that dimension could be determined (Croney, 1980:3).

People's body shapes change often. Age causes the body to change in both shape and height. As the body ages, the most predictable physical changes are the expansion of waist and abdominal girth, combined with the shortening and curvature of the spinal column. For women in particular, as posture changes, body fat increases and tends to concentrate in certain areas such as the waist, hips and thighs. However, between the ages of 50 and 70, body fat decreases at an average rate of 1% annually. Therefore, dimensions are increasingly overestimated for elderly consumers (Le Pechoux & Ghosh, 2002:3). The design changes required to

properly fit this age category are not confined to vertical and horizontal measurements. Adjustments should also be included for additional curvatures due to the diversity of posture affecting the hang of garments (Le Pechoux & Ghosh, 2002:3).

2.3.5.4 Region

There are regional differences in growth that cannot be explained in terms of nutrition or climate but would seem to depend on genetic factors peculiar to the region (Croney, 1980:31). There can be some delay in growth rates of children in hot climates. These differences may be in part responsible for the range of physique to be seen in man globally. The findings of anthropometric surveys in England on children at adolescence show that a superior environment can result in an increase in total height from 38mm to 50mm. An inferior environment might cause a loss of expected height of 38mm. During infancy, loss or gain shown in total height, due to the same factors, is about 13mm. There is evidence that the regional factors can be true for European and North American populations (Croney, 1980:31).

2.3.5.5 Ethnic differences

A comparative study of variations in body sizes was conducted by the Center for Ergonomics of Developing Countries (CEDC) in Sweden (Le Pechoux & Ghosh, 2002:4). The results reveal differences in almost every part of the human body between the different countries, resulting in diversities of body proportions. For example, it is noted that the Japanese population, on average, has body trunks that are larger than their limbs. Differences are particularly striking between industrialised countries and industrially developing countries (Le Pechoux & Ghosh, 2002:4). It seems that people of industrialised countries, who are generally taller, also have longer legs and arms, the only exception being Africans. Nearly all the people with shorter limbs are from industrialised developing countries, except the Japanese. Considering the statures, sitting height, and body proportions, similarities are observed between groups of countries (Le Pechoux & Ghosh, 2002:4). It is also noted that the Asian population always has the smallest dimensions, while the black population has the largest dimensions for length measurements and the white population has the largest dimensions for the girth measurements (Le Pechoux &

Ghosh, 2002: 4)

2.3.5.6 Changing lifestyles

Le Pechoux and Ghosh (2002:8) are of the opinion that with the popularity of sport, and improvement in nutrition, hygiene and living standards, the population is becoming healthier, stronger, and more slender. A stronger built is gradually replacing petite sized figures, and people of all age groups are becoming more aware of their body and form. A person's lifestyle can directly affect his or her body fat versus muscle content. The way these tissues are distributed along the body can also depend on the right-left asymmetry of that specific body, as well as posture.

2.3.6 Previous anthropometric studies in clothing

The following are a few surveys of body measurements already done all over the world.

2.3.6.1 General international and national surveys

Two researchers from the University of Arizona developed a program that involved a nation-wide study to measure and interview 5000 to 8000 women 55 years of age and older. The research was performed using an ultra fit sizing system. This study was undertaken to establish the first large scale body measurement database specifically of women aged 55 and older (Goldsberry et al., 1995:108).

Beazley (1997:55) also conducted research in anthropometry for pattern and garment construction. The survey explains how to undertake an anthropometric survey and compile size charts, select measurements which should be taken and suggests appropriate equipment.

The American Society for Testing and Materials (ASTM) conducted a study that provided a set of specific body measurements for women 55 years and older. The study identified key body dimensions that are related to garment fitting problems for this group (Le Pechoux & Ghosh, 2002:3).

The National Institute of Standards and Technology (NIST) has been conducting extensive research on apparel sizing and related issues since 1994. The work is based on the comparison of five industry body measurement reports, including national and international apparel sizing standard documents. This information provides the basis for the development of a standard model for made-to-measure pattern making and aims at setting up future body measurement surveys as well as the development of new improved sizing standards (Le Pechoux & Ghosh, 2002:16).

Mlawuli, a South African researcher, conducted a national survey on the full body measurements of black women aged between 20 and 54 in all the provinces of South Africa (Moritz, 2000:41).

2.3.6.2 Surveys on children

The first recorded anthropometric survey on children was conducted between 1937 and 1939 by the Textile and Clothing Division of the US Department of Agriculture (Otieno & Fairhurst, 2000:144). This survey included 147 000 American children. The purpose was to create uniformity among manufacturers of children's clothes and also to establish a sizing system based on height and hip girth. The report formed a landmark in the development of sizing systems (Otieno & Fairhurst, 2000:144).

The Clothing Design and Technology Department of Manchester Metropolitan University conducted an anthropometric survey on 618 Kenyan female children in the age group two to six years (Otieno & Fairhurst, 2000:153). Aldrich (1999:5) conducted a research project on children between two and fourteen years. A field study on measurements was undertaken and the measurements collected provided the necessary data required to produce size charts and to construct basic pattern blocks. A total of 1,783 boys and girls was measured. The study was contracted to ensure that the children measured, reflected the spread of children in the general population.

The British Standards Institution's survey was done by the University of Loughborough. Specifications for size designation were published for children's wear and

recommendations of body dimensions for children in June 1990. Their primary aim was the establishment of a size designation system which indicates the body size of the child or infant that a garment is intended to fit (Aldrich, 1999:5).

Two senior garment technologists of a well-known retail group conducted a survey on children's body sizes in South Africa. The survey was conducted on behalf of a group of eight South African clothing retailers. The survey was done in Gauteng and in the Cape Province (Moritz, 2000:41).

2.4. CONCLUSION OF LITERATURE REVIEW

The discussion of the literature above, suggests that South African clothing industries need to adjust the size charts that they are currently using, in order to eliminate the sizing and fitting problems which exist. To cater for all the children in this country, size charts should be constructed and divided in accordance with the way a child's body develops and other anthropometric variables should also be considered. These concerns led this investigator to conduct research on anthropometric measurements of black South African children.

CHAPTER THREE

3 RESEARCH METHODOLOGY

3.1 INTRODUCTION

In chapter two the theoretical concepts and anthropometric research relevant to this study were discussed. These concepts served as the foundation on which the empirical study was based. An appropriate methodology was used to ensure a sound foundation on which scientific findings can be based as well as from which valid conclusions can be made.

This project was part of the larger multi-disciplinary project THUSA BANA of the focus area at the university (see Appendix A). The main aim of this multi-disciplinary project was to study the problem of overweight and obesity (Nutrition) as well as several other related aspects, like blood pressure (Physiology) and physical activity (Biokinetics), among school children aged 10–15 years in the North-West Province. As this main aim involves anthropometric measurements, it was a natural consequence to take the necessary body measurements for use in pattern design and clothing construction.

3.2 NATURE OF STUDY

A one time cross sectional, descriptive and exploratory study was used, applying a survey method. According to Compton and Hall (1972:139) a survey is regarded as a formal procedure by which information is obtained that is more or less isolated from the values, convictions and presuppositions of the researcher and client or reader. Survey research is reasonably free from the personal bias of the researcher and client. It provides data that is more reliable, credible and objective than personal assumptions and prejudice.

3.3 THE VARIABLES

The first step was to obtain the measurement charts used by the industry (see Appendix B). Measurement charts of three companies were obtained and the data was compared. The measurements on two of the charts were the same and it was

decided to use one of them, as the third one differed greatly from the other two and it was compiled for unisex sizes which would not be applicable for this study. From the measurement chart chosen, a data chart was developed to use for the survey, including some demographics like age, gender and school (see Appendix C). A survey was undertaken by the researcher for this study. Measurements were taken from 718 black children and the age group included children between 10 and 14 years old. From this group, 293 were boys and 425 were girls.

3.4 SURVEY SAMPLING METHOD

The sampling procedure was done in consultation with the Statistics department of the Potchefstroom University. Random sampling was used as a sampling method for the survey. The sampling method chosen yielded probability samples, which ensured that each subject in the sample had the same probability or equal chance or opportunity of being selected or included in the sample (Mulder, 1989:57). The advantage of random sampling is that it excludes bias and provides a statistical means for estimating sampling errors. Its weakness is that for large samples and large sampling frames, it becomes a tremendous job unless it is computerised (Mulder, 1989:58).

A list of schools was obtained from the North-West Department of Education. A total number of 44 schools, including schools from rural areas, was randomly selected and within each school a sample of each age group was randomly selected. The parents of the participating children had to sign an indemnity form (see Appendix A) to make sure that participants took part voluntarily. Permission to undertake the survey was given by the ethic committee of the Potchefstroom University, (number OO-M10). The study was planned to ensure that the children measured represented the children in the general population.

Thirteen measurements were selected in correspondence with the measurements on the measurement charts used by the industry. The researcher believes that these measurements can give an indication whether there is a significant difference between the existing measurements used by the clothing industry and the body measurements of black adolescent South Africans.

3.5 DATA COLLECTION

The researcher, with the assistance of a trained fieldworker, a supervisor and a local language (Tswana) speaking grown-up, took the measurements from the chosen sample of adolescent children at the selected schools in the North-West province of South Africa. The trained fieldworker from Potchefstroom was selected from a previous trained fieldworker team on a measuring project. The project took place over a period of thirteen months from 8th May 2001 to 8th June 2002. Trained and qualified students from the school of Biokinetics and Sport science, took some of the required anthropometric measurements, (head circumference, waist, biceps and the height) which were used for this study, to eliminate duplication.

3.6 MEASURING EQUIPMENT AND PROCEDURES

To undertake this survey among adolescent boys and girls, the measuring method and procedure had to be selected. The procedure was based on methods from previous surveys described in the literature. This required a review of previous surveys (Beazley, 1997:58).

3.6.1 Tape-measure method

It is important to note that measuring the human body manually is not an easy task. Much is left to the judgement of the measurer, such as land-marking of the body, positioning of the equipment and tension of the tape measure. However, with training practice and precision, measuring errors can be minimised. At present, manual measuring is still the most reliable and cheapest method available. This measuring method has been used successfully by other researchers (see chapter 2, 2.3.6.1).

A flexible tape measure was used during this survey to measure the length and girth of the boys and girls in the North-West Province. A good tape measure, made of glass fibre with metal tips at each end, and does not stretch or fray, was used to ensure validity and reliability. The centimetre division is shown on both sides, starting from opposite ends. The tape measure method requires intensive training of the measurer. A workshop was held during which the taking of all the

measurements was first demonstrated followed by several practise sessions during which the trainees had to take measurements under supervision of the study leader. They had to complete a test during which their skills were assessed. A tape measure is good for taking short measurements across the body as well as for length measurements.

3.6.2 Other equipment used

The other equipment used for this survey included:

- ◆ a ribbon, 140cm long and 1cm wide, to indicate the waistline,
- ◆ a string of beads to measure the neck (the beads follow the natural line of the neck and the measurements are taken by a tape measure from the string of beads),
- ◆ an eyebrow pencil for land marking and a pencil for recording the measurements,
- ◆ a piece of cardboard with footmarks for the subject to stand on when measurements are taken,
- ◆ a mirror to control the measurement procedures properly and
- ◆ a stadio meter to measure the height.

3.6.3 Preparation for measuring

Preparation was deemed very important for accuracy. The subject had to take off his/her clothes and shoes and appear in underclothes or tight swimwear. Landmarks were made, using an eyebrow pencil to ensure that measurements were accurate and constant. A ribbon was positioned at the waistline while the child was taking in his/her breath and the waistline position was marked, but the ribbon was only tied when the child's tummy was relaxed. Most measurements were taken from the front, back or right side, depending on the measurement to be taken. The child had to stand upright when measurements were being taken.

Great care had to be taken when preparing the subject. If the positioning of the landmarks and tape as described was not done accurately, the measurements would not be valid. It was easy to locate and position the landmarks on the bone prominence. However, when placing them on the flesh areas the precision was left

to the measurer, especially when both the left and right side of the body had to be marked evenly, for example around the neck area. It was also necessary to see that all the girth measurements defined by a measuring tape were taken parallel to the ground and re-checked during measuring. According to Beazley (1999:72) it takes approximately 5 to 10 minutes to prepare a person for measuring.

3.6.4 The landmarks

The nape: the head was lowered to locate the nape. This junction was then marked with a cross by using pencil. The nape is the most important position and all measurements can be related back to this position (Beazley, 1997:62)

The shoulder point: the measurer located the end of the acromio-clavicular joint and positioned a cross on both right and left shoulders (Beazley, 1997:62).

The neck-base: marks are placed at the shoulder/neck point perpendicular to the ear and in centre front on the line that was formed by the string of beads.

3.7 MEASUREMENTS TAKEN

The measurements were taken in the sequence of the measurement charts of the industry. All the measurements were taken according to the standard procedures used by Beazley (1998:280) and Aldrich (1999:12). The measurements are illustrated on the following photos.

3.7.1 Height is taken with the subject standing erect on a stadio meter with his/her back to the rod, feet together and arms relaxed at his/her sides. The measurer locates the top of the subject's head, and takes the reading from the stadio meter.

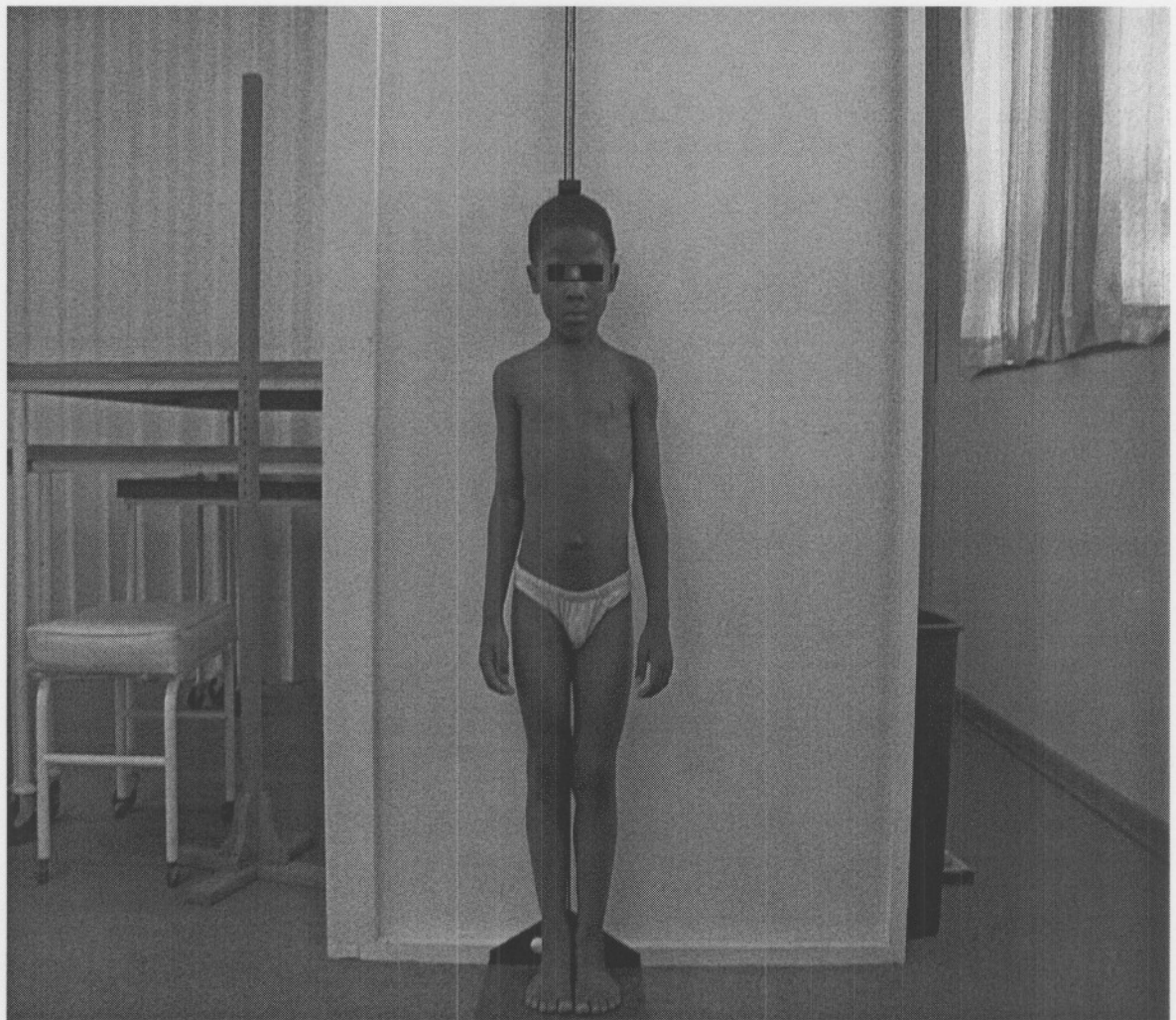


Figure 2: Height measurement

3.7.2 Chest / bust refers to the maximum girth measurement under the armpits with the tape passing over the shoulder blades and across the chest or bust.

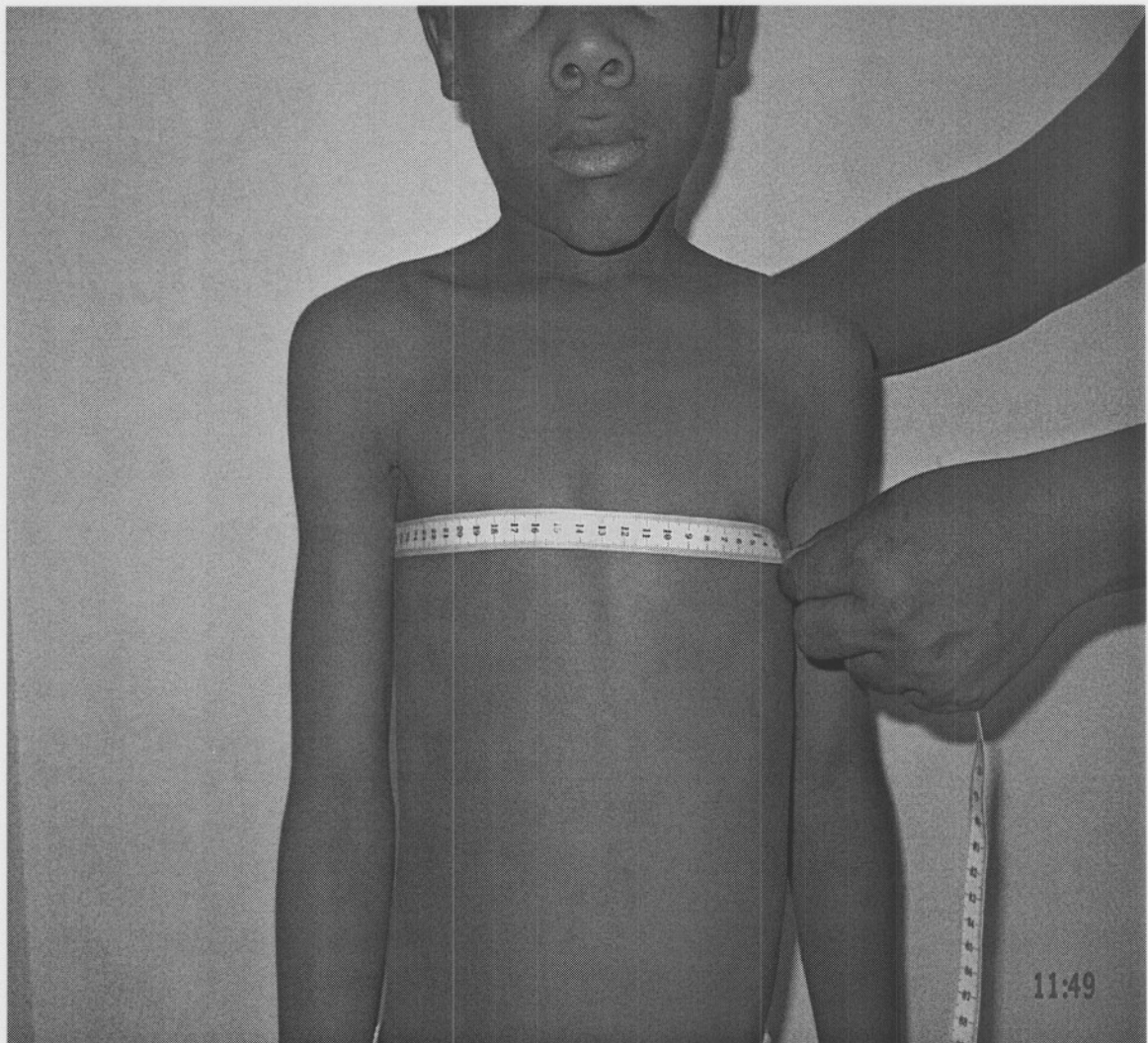


Figure 3: Chest measurement

3.7.3 **Waist** refers to the measurement of the natural waist girth measurement with the child's abdomen relaxed.



Figure 4: Waist measurement

- 3.7.4** **Waist-to-hip** refers to the measurement taken from the waist-line to the hip/seat line (see 3.7.5) on the right side of the body.

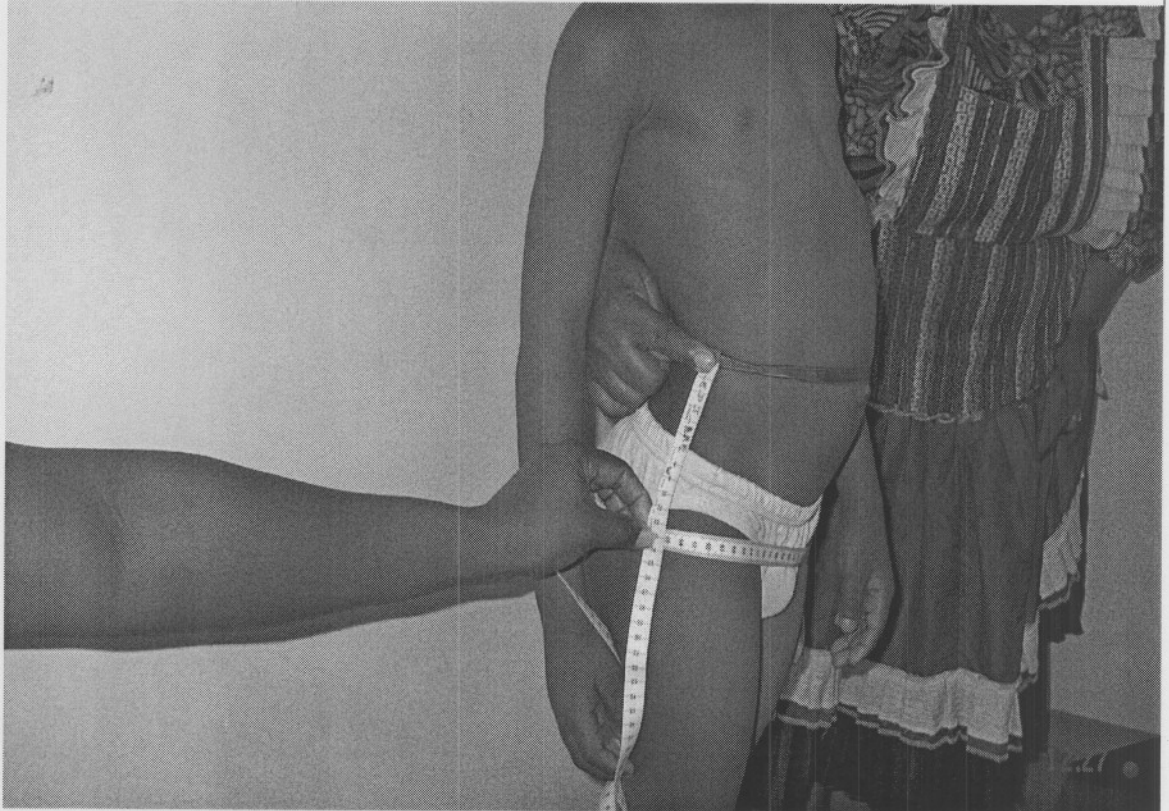


Figure 5: Waist-to-hip measurement

3.7.5 Hipline is the horizontal measurement taken round the fullest part of the seat.

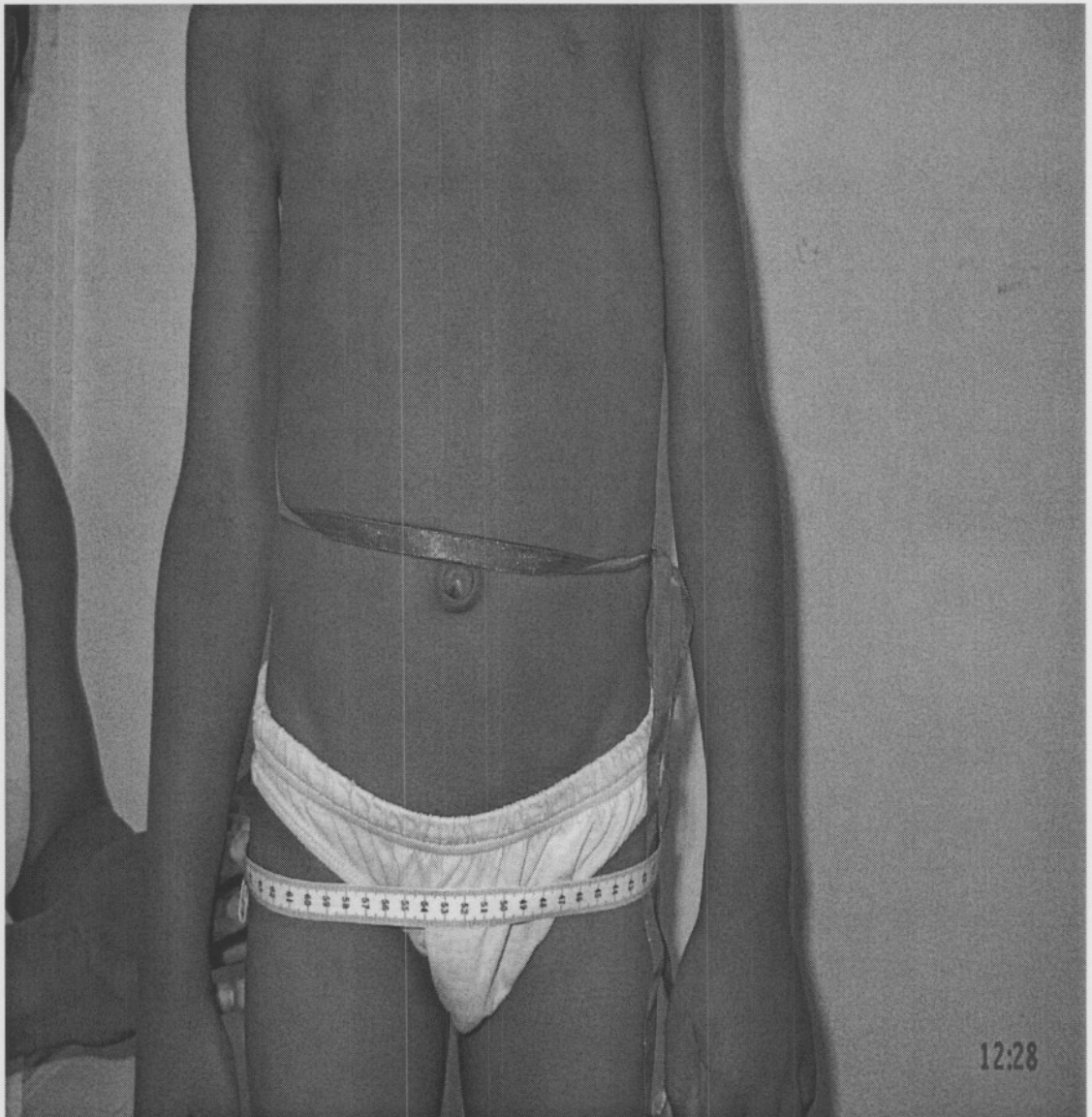


Figure 6: Hipline measurement

3.7.6 Shoulder is the measurement taken from the base of the side neck landmark to the shoulder edge landmark.



Figure 7: Shoulder measurement

3.7.7 Head circumference is the horizontal girth of the head taken around the forehead.

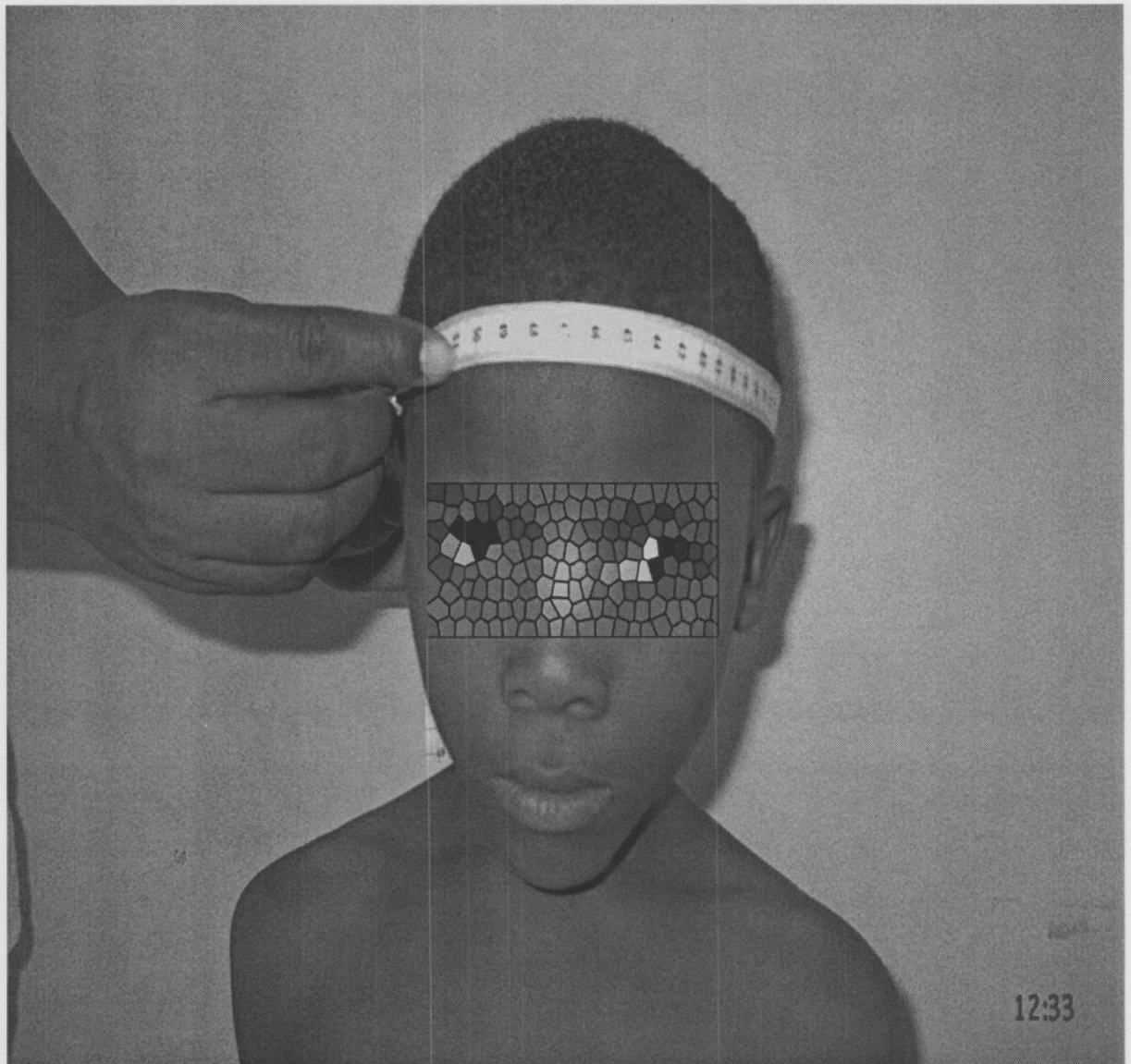


Figure 8: Head circumference measurement

- 3.7.8 Neck-base** is the length of the bead-chain taken from the chain position around the neck, touching the 7th cervical at the back and the upper borders of the collarbone at front.

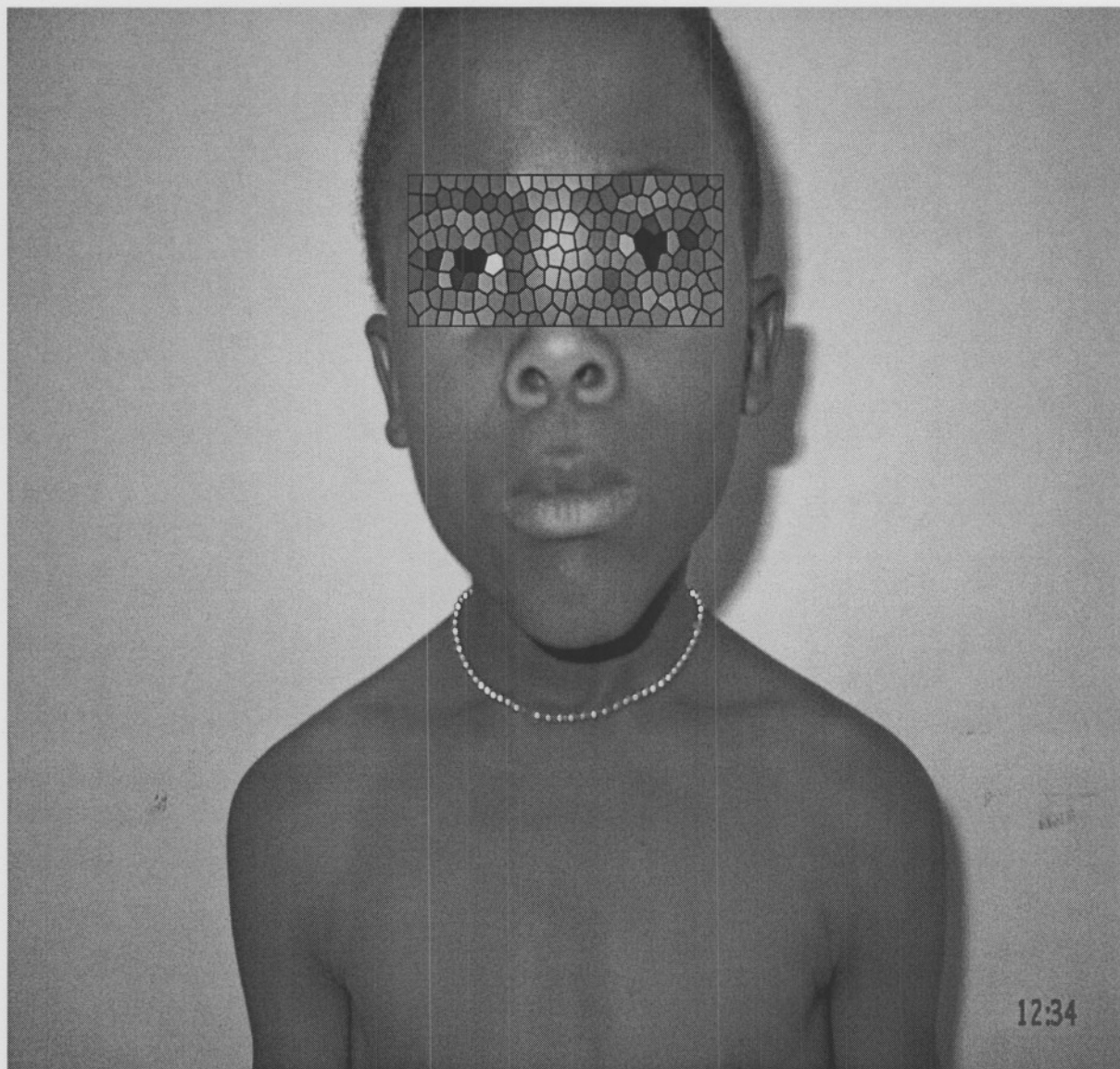


Figure 9: Neck-base measurement

3.7.9 Biceps (upper arm) is the measurement taken in a straight line at the widest point of the upper arm with the arm relaxed.



Figure 10: Biceps measurement

- 3.7.10** Thigh measurement is taken horizontally around the thickest part of the right upper thigh just below the crutch level.



Figure 11: Thigh measurement

3.7.11 Back-nape-to-waist is the measurement taken from the nape vertically down the centre back to the lower edge of the waist level. The subject stands with his/her back to the measurer.

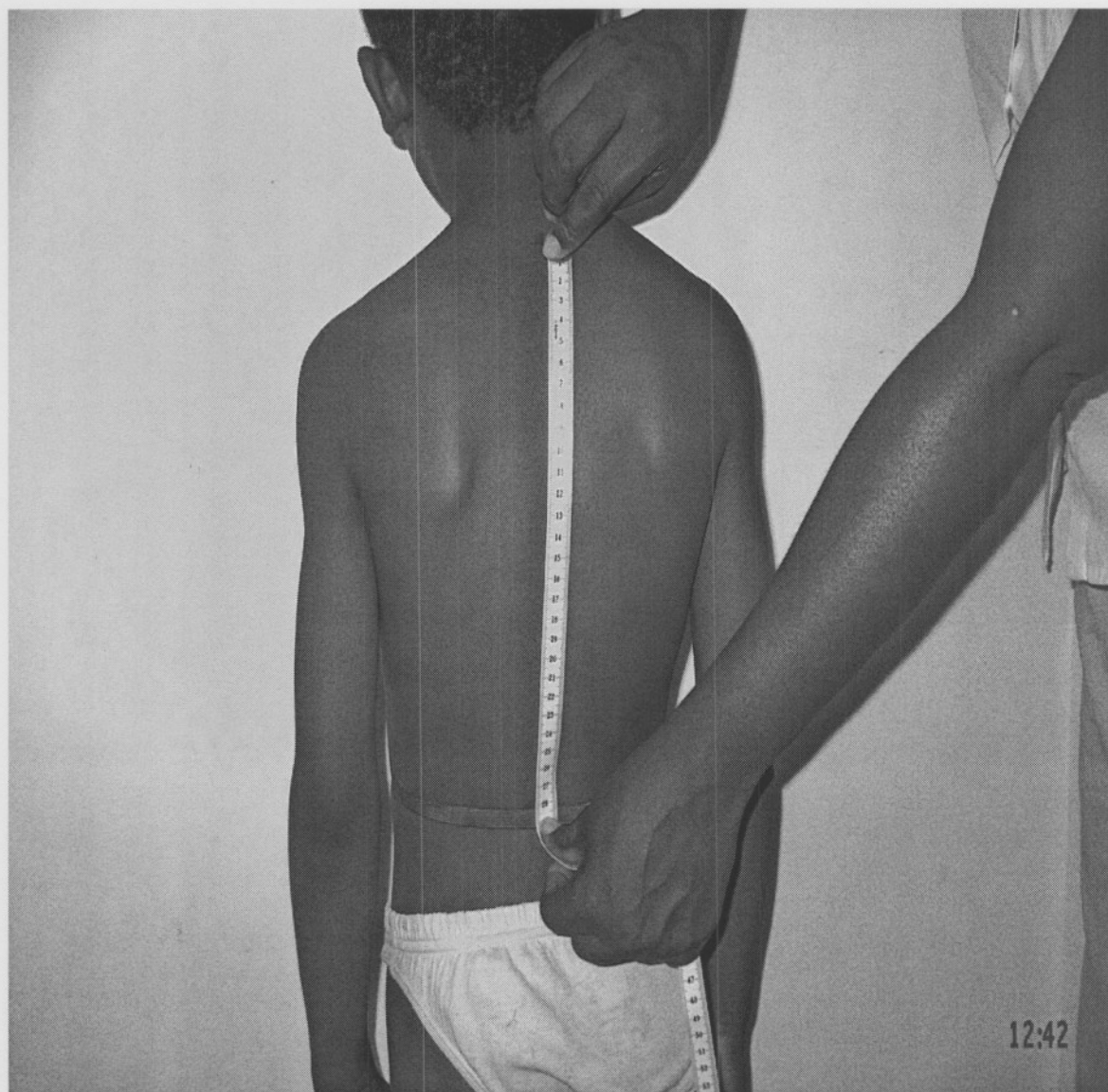


Figure 12: Back-nape-to-waist measurement

3.7.12 Side-waist-to-floor is the measurement taken from the waist vertically down to the ankle through to the ground.

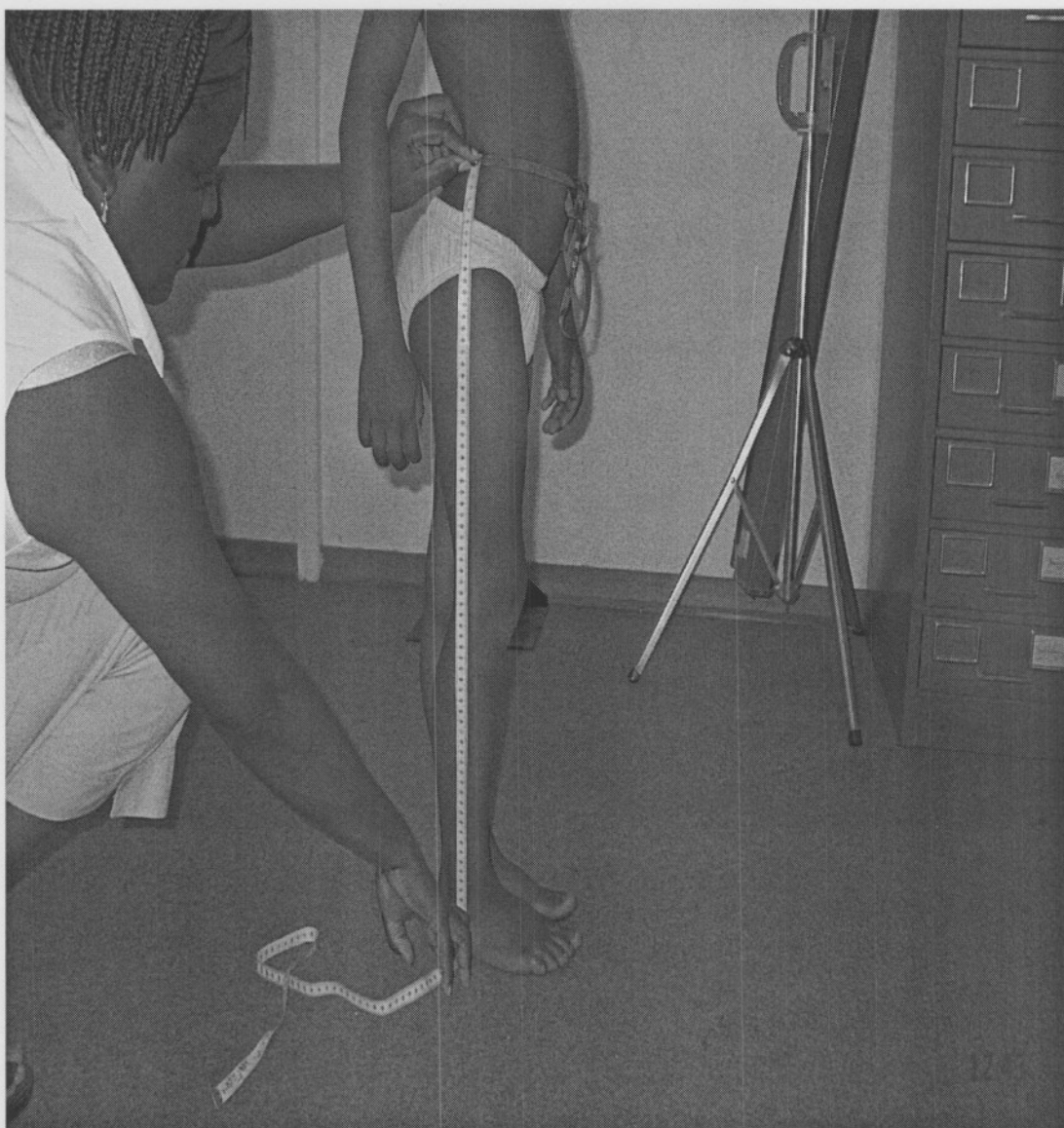


Figure 13: Side-waist-to-floor measurement

3.7.13 Inside-leg-to-floor is the measurement taken from the crotch to the floor along the feet.



Figure 14: Inside-leg-to-floor measurement

3.8 STATISTICAL ANALYSIS OF DATA

The anthropometric data was analysed by using a computer programme (The SAS systems for Windows Release 8.02TS Level 02M0). Today the statistical analysis is a quick and comparatively easy task using a computer. The data from the survey of adolescent girls and boys was analysed statistically to compare the body measurements of the black children with those of the industry. The statistical techniques used for data analysis are explained below.

3.8.1 Mean

The mean is the best single measure to describe a distribution of measurements. Every single score is taken into account in its calculation (Mulder, 1989:17). The mean is the average of the values given. It is also defined as the sum of the values divided by the number of values (Beazley, 1998:260). The formula is

$$\bar{x} = \Sigma x / n \text{ (Mulder, 1989:18).}$$

Where $\bar{x}$ = the mean of the sample

Σx = the sum of the values

n = the sample size

3.8.2 Standard deviation

This is the concept used to describe variability. It corresponds to the description of the average deviation but takes it a step further (Mulder, 1989:24). With the average deviation, only the highest and the lowest scores are taken into consideration, and it makes no difference how the scores between them may vary (Mulder, 1989:24). The standard deviation expresses the spread of values around the mean. The formula is:

$$s = \sqrt{\frac{\Sigma (x - \bar{x})^2}{n}}$$

Where s = standard deviation x = each separate score

$\bar{x}$ = the arithmetic mean n = the number of scores

3.8.3 Coefficient of variation

The coefficient of variation is used for assessing relative variation rather than absolute variation. It is useful for comparing variation in two distributions of the same variable having different means, or for comparing two distributions when the same dependent variable is measured in different units. The coefficient of variation is a quality variable of use to the experimenter in evaluating results from different experiments involving the same character, possibly conducted by different persons (Steel & Torrie, 1980:27). The coefficient of variation is also useful in comparing the results obtained by different persons who are conducting investigations involving the same variable. The formula is:

$$C.V. = s / \bar{x} (100)$$

Where C.V. = coefficient of variation

s = standard deviation

$\bar{x}$ = average mean of the sample

3.8.4 t-tests

t-tests are used in research with smaller samples from populations with normal distributions. The research will be characterised with respect to one sample, the two sets of matched data, (Mulder, 1989:141).

3.8.5 p-value

When dealing with small samples from populations, a statistical significance test is the standard way to compare population means in cases where statistical significance was established (i.e. when nil-hypotheses were rejected or the P-values were small. Normally a p-value smaller than or equal to 0.05 is taken as statistically significant (Mulder, 1989:145; Steyn, 1999:1).

3.8.6 d-value

This value is particularly of importance when dealing with samples to show the significant differences between sets of data. The statistically significant differences between the means of two sets of data (the industry and the black children) at a 5% level might not be very useful information for the industry to work on. If an effect size (which does not depend on the sample size) indicated by the d-value as a

measure of significance is used, it is possible to make a judgement concerning the importance of the difference between the means (Steyn, 1999:2). To estimate d, the following formula is used:

$$d = \frac{\bar{x}_1 - \bar{x}_2}{s}$$

Where $\bar{x}_1$ = the mean of the industry,
 $\bar{x}_2$ = the mean of the black children, and
 s = the standard deviation

Cohen (1988:224) gave some guideline values in the interpretation of the d-value for instance

- d = 0.2 is a small difference and might not be useful
- d = 0.5 is a medium difference and might be moderately useful
- d = 0.8 is a big difference and of practical importance.

3.9 RELIABILITY AND VALIDITY OF THE STUDY

The reliability and validity of this study depended on the accuracy of the measurer when land-marking the body, positioning the equipment and controlling the tension of the measuring tape. The type of measuring tape used in this study ensured the reliability and validity of the results. The measuring tape and the stadio meter were correctly calibrated. Standard techniques for taking anthropometric measurements recognised world-wide were used to ensure validity. The measurements were also taken by a trained fieldworker, and repeated when the measurer was not certain of the reading, to ensure reliability and to minimise errors. The readings for all the measurements taken, were entered into the computer by the researcher after error analysing was done. The supervisor re-checked whether all the readings were entered correctly in order to minimise errors. Much was left to the judgement of the measurer. Errors in anthropometry can never be avoided completely but additional training and experience of the measurer can reduce them. The methodology to execute the survey was described in this chapter, giving information on the sample selection and measuring techniques. In the next chapter the results of the measurements taken will be analysed and discussed.

CHAPTER FOUR

4. RESULTS AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

The aim of the study was to compare the body measurements needed for pattern and clothing construction of black children aged 10-14 years with the measurements used by the clothing industries in South Africa. This chapter focuses on the statistical analysis of data, the results and the discussions. The anthropometric data were analyzed by using a SAS (2001) computer program (The SAS System for Windows Release 8.02 TS Level 02MO).

The mean differences between measurements of adolescent girls and boys aged between 10 and 14 years of the North-West Province and those of the industry were determined.

The coefficient of variance was also determined to investigate variability. The t-values were determined to indicate the statistical differences, though the t-values will not be discussed further.

The p-values were determined to indicate if the differences were statistically significant and the d-values were determined to indicate the practically significant difference. The p-values were interpreted as statistically significant on a $p \leq 0.05$ level. The d-values were interpreted as follows (Cohen, 1988:20-27):

d=0.3 small difference

d=0.5 medium difference

d=0.8 large difference (practically significant).

The data is arranged in tables according to ages, indicating the differences between measurements used by the industry and the measurements of the black children of the North- West Province. The hypothesis that these two sets of measurements differ will only be accepted in cases where the measurements differ statistically as well as practically significantly.

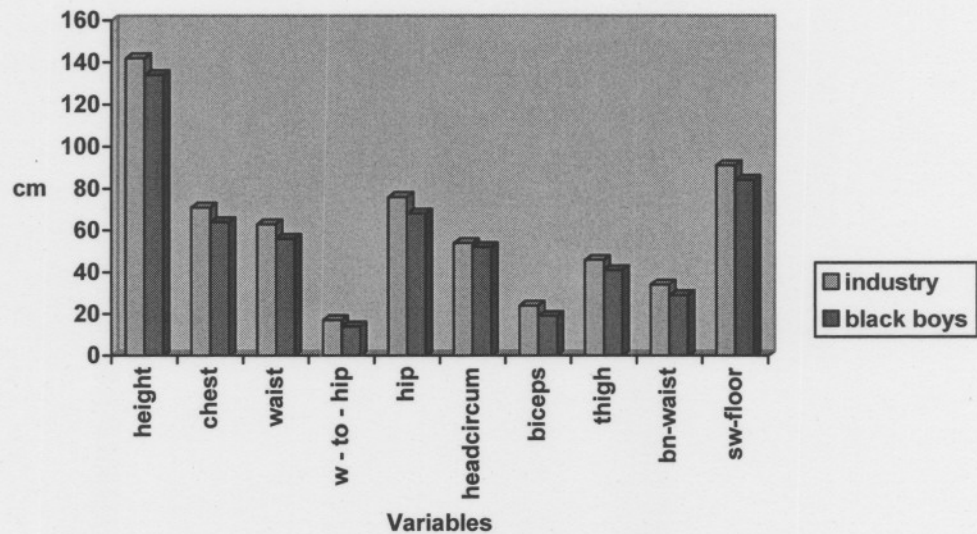
The measurements of the boys will be discussed first. Each measurement table will be followed by a graph in which the measurements that are statistically as well as practically significant will be depicted and discussed. A synopsis of the boys' results will then follow. In addition the height and chest measurement differences between the industry and the black boys will be illustrated by means of graphs and discussed. The same procedure will be followed for the girls. The waist and height measurement differences between the industry and black girls will also be illustrated by means of graphs and discussed.

4.2 RESULTS AND DISCUSSION OF THE BOYS' MEASUREMENTS

4.2.1 Ten year old boys

TABLE 4.1 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 10 YEAR OLD BLACK BOYS AND INDUSTRY (N=46)

Variables	Industry (cm)	Black boys (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance%
1. Height	142.00	133.70	8.30	5.63	10.75	<.0001	1.58	4.23
2. Chest	71.00	63.84	7.16	3.45	14.09	<.0001	2.08	5.40
3. Waist	63.00	55.60	7.40	4.22	11.90	<.0001	1.76	7.59
4. Waist-to-hip	17.00	13.88	3.12	2.28	9.30	<.0001	1.37	16.40
5. Hip	76.00	68.16	7.84	8.82	6.03	<.0001	0.89	12.95
6. Shoulder	10.50	10.55	-0.05	1.04	0.35	0.7259	—	9.90
7. Head circumference	54.00	52.37	1.63	1.58	6.77	<.0001	1.03	3.01
8. Neck base	33.40	34.48	-1.08	2.03	3.60	0.0008	0.53	5.90
9. Biceps	23.00	18.69	4.31	1.83	15.93	<.0001	2.35	9.81
10. Thigh	46.00	41.00	4.62	4.70	6.67	<.0001	0.98	11.35
11. Back-nape-to-waste	34.00	29.16	4.84	2.24	14.67	<.0001	2.16	36.00
12. Side-waist-to-floor	91.00	84.24	6.76	5.20	18.82	<.0001	1.30	6.17
13. Inside-leg-to-floor	69.00	65.34	3.69	11.11	2.24	0.0304	—	17.01



w-to-hip: waist-to-hip
bn waist: back-nape-to-waist

headcircum: head circumference
sw floor: side-waist-to-floor

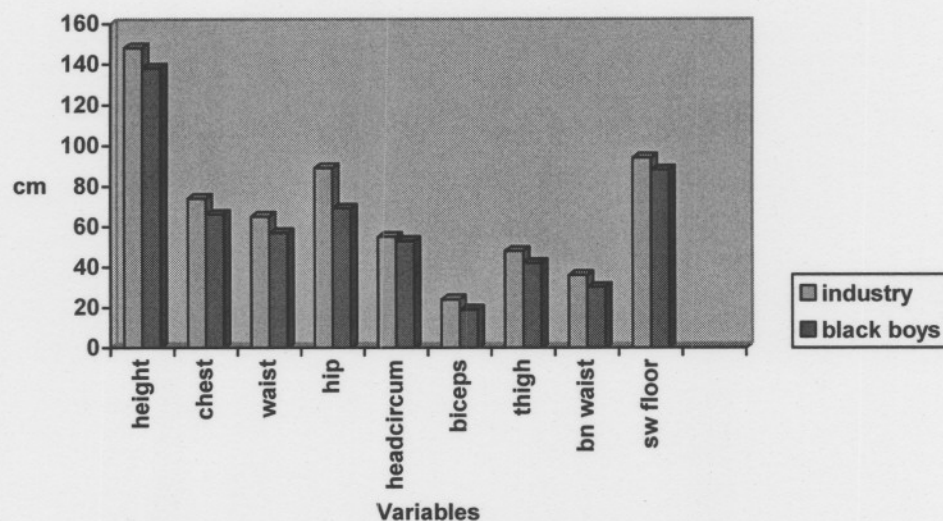
Figure 15: Practically significant differences between the body measurements of 10 year old black boys and those of the industry

According to Table 4.1 and Figure 15, the highest mean difference for this age group is represented by the difference in biceps ($d=2.35$), followed by the back-nape-to-waist ($d=2.16$) and chest ($d=2.08$). The biggest variation in the black boys' measurements was encountered in the back-nape-to-waist measurements (36%). Twelve variables (92 %), namely the height, chest, waist, waist-to-hip, hip, head circumference, neck-base, biceps, thigh, back-nape-to-waist, side-waist-to-floor and inside-leg-to-floor indicate that there is a statistically significant ($p \leq 0,05$) difference between the industry's measurements and the measurements of the 10 year old black boys. A practically significant difference ($d=1.03-2,35$) is demonstrated by the listed variables, except for neck-base and inside-leg-to-floor. The hypothesis that the measurements of the ten year old black boys differ from those of the industry can be accepted for the ten variables depicted in Figure 15.

4.2.2 Eleven year old boys

TABLE 4.2 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 11 YEAR OLD BLACK BOYS AND INDUSTRY (N = 65)

Variables	Industry (cm)	Black boys (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance %
1.Height	148.00	138.48	9.52	8.31	9.23	<.0001	1.14	6.00
2. Chest	74.00	65.51	8.49	3.25	21.06	<.0001	2.61	4.96
3. Waist	65.00	56.76	8.24	3.48	19.06	<.0001	2.36	6.14
4. Waist-to-hip	18.00	15.62	2.38	7.27	2.64	0.0105	—	46.53
5. Hip	89.00	68.88	20.12	8.27	19.62	<.0001	2.43	12.00
6. Shoulder	10.80	10.88	-0.08	1.28	0.53	0.5960	—	11.76
7.Head circumference	55.00	52.83	2.17	1.53	10.59	<.0001	1.42	2.90
8. Neck base	34.20	34.87	-0.67	2.09	2.57	0.0124	—	5.99
9. Biceps	24.00	18.97	5.03	1.18	34.46	<.0001	4.27	6.20
10.Thigh	48.00	41.64	6.36	4.08	12.58	<.0001	1.56	9.79
11.Back-nape-to-waist	36.00	30.28	5.72	2.46	18.50	<.0001	2.33	8.13
12.Side-waist-to-floor	94.00	88.21	5.79	4.66	10.02	<.0001	1.24	5.12
13.Inside-leg-to-floor	71.00	69.28	1.72	4.12	13.37	0.0013	0.42	5.95



headcircum: head circumference
sw floor: side-waist-to-floor

bn waist: back-nape-to-waist

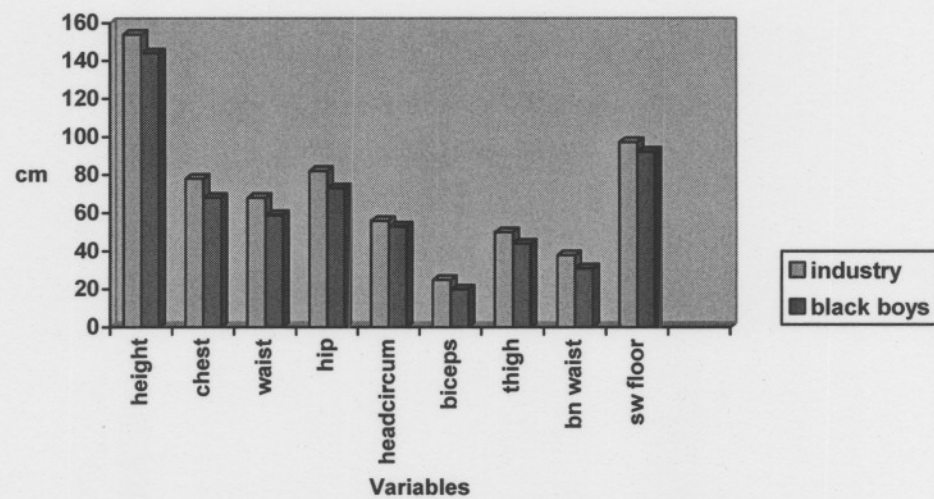
Figure 16: Practically significant differences between the body measurements of 11 year old black boys and those of the industry

According to Table 4.2. and Figure 16, the highest mean difference for this age group is represented by the difference in biceps ($d=4.27$), showing that the biceps measurement of black boys of this age is considerably smaller than that used by the industry. Other variables such as the chest, hip, waist and back-nape-to waist also show a noticeable difference between the measurements of the eleven year old boys and those of the industry. A very high variation (46.53%) was found for the waist-to-hip measurement for this age group. Twelve variables (92%), namely the height, chest, waist, waist-to-hip, hip, head circumference, neck-base, biceps, thigh, back-nape-to-waist, side-waist-to-floor and inside-leg-to-floor display a strong statistically significant difference at the 0.05% level of significance. There is also a practically significant difference between nine of the industry's measurements and those of the black children of this age group. The shoulder length is the only measurement that doesn't differ between the two groups. The hypothesis that the black boys' measurements differ from those of the industry can be accepted for the nine variables depicted in Figure 16.

4.2.3 Twelve year old boys

TABLE 4.3 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 12 YEAR OLD BLACK BOYS AND INDUSTRY (N = 83)

Variables	Industry (cm)	Black boys (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance %
1. Height	154.00	143.74	10.26	6.53	6.53	<.0001	1.57	4.55
2. Chest	78.00	67.59	10.41	7.26	7.26	<.0001	1.44	10.74
3. Waist	68.00	59.17	8.83	5.28	5.28	<.0001	1.67	8.92
4. Waist-to-hip	19.00	16.25	2.75	6.44	6.44	0.0002	—	39.61
5. Hip	82.00	73.35	8.65	10.54	10.54	<.0001	0.82	14.37
6. Shoulder	11.00	11.05	0.05	1.44	1.44	0.7324	—	13.03
7. Head circumference	56.00	53.27	2.73	1.62	1.62	<.0001	1.68	3.05
8. Neck-base	35.00	36.71	-1.71	2.74	2.74	<.0001	0.62	7.47
9. Biceps	25.00	19.66	5.34	1.60	1.60	<.0001	3.33	8.16
10. Thigh	50.00	43.97	6.03	5.88	5.88	<.0001	1.03	13.38
11. Back-nape-to-waist	38.00	30.88	7.12	2.11	2.11	<.0001	3.37	6.83
12. Side-waist-to-floor	97.00	92.22	4.78	5.37	5.37	<.0001	0.89	5.83
13. Inside-leg-to-floor	73.00	70.49	2.51	8.72	8.72	0.0103	0.29	12.36



headcircum: head circumference
sw floor: side-waist-to-floor

bn waist: back-nape-to-waist

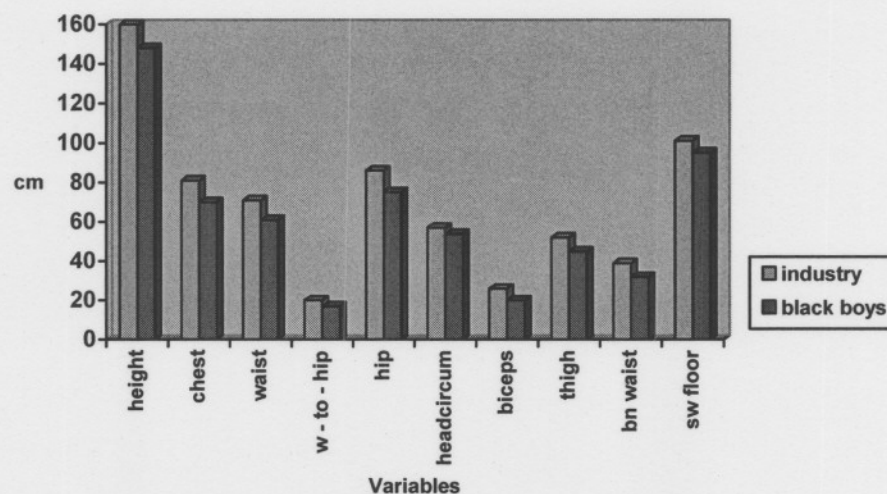
Figure 17: Practically significant differences between the body measurements of 12 year old black boys and those of the industry

According to Table 4.3 and Figure 17 most of the means show a significant difference between the industry's measurements and the measurements of the black boys of this age group. The biggest differences are in the back-nape-to-waist measurements ($d=3.37$) and the biceps measurement ($d=3.33$). A high variation (39,61%) is shown by the waist-to-hip measurement of the black boys. Twelve variables, which is almost 92% of the measurements, demonstrate a statistically significant difference ($p \leq 0.05$) between the measurements of the black boys of this age group and those of the industry. The variables are: height, chest, waist, waist-to-hip, hip, head circumference, neck-base, biceps, thigh, back-nape-to-waist, side-waist-to-floor and inside-leg-to-floor. Nine of the measurements also show a practically significant difference as portrayed in Figure 17. For this age group the hypothesis that the measurements of the black boys differ from those of the industry can be accepted for the nine variables depicted in Figure 17.

4.2.4 Thirteen year old boys

TABLE 4.4 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 13 YEAR OLD BLACK BOYS AND INDUSTRY (N=54)

Variables	Industry (cm)	Black boys (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance %
1. Height	160.00	147.74	12.26	8.07	11.17	<.0001	1.52	5.46
2. Chest	81.00	69.58	11.42	8.99	9.34	<.0001	1.27	12.91
3. Waist	71.00	60.69	10.31	5.04	15.01	<.0001	2.04	8.31
4. Waist-to-hip	20.00	16.80	3.92	2.42	11.90	<.0001	1.62	15.03
5. Hip	86.00	75.28	10.72	6.47	12.18	<.0001	1.66	8.59
6. Shoulder	11.50	11.37	0.13	1.51	0.63	0.5313	—	13.29
7. Head circumference	57.00	53.57	3.43	1.64	13.86	<.0001	2.09	3.07
8. Neck-base	35.80	37.08	1.28	2.57	3.66	0.0006	0.50	6.93
9. Biceps	26.00	20.45	5.55	1.86	21.96	<.0001	2.99	9.08
10. Thigh	52.00	45.35	6.65	8.13	6.01	<.0001	0.82	17.92
11.Back- nape-to- waist	39.00	32.44	6.56	2.85	16.91	<.0001	2.30	8.80
12.Side- waist-to- floor	101.00	95.10	5.99	6.14	7.17	<.0001	0.98	6.46
13.Inside- leg-to-floor	76.00	71.61	4.36	12.22	2.62	0.0114	—	17.06



w- to - hip: waist-to- hip
bn waist: back-nape-to-waist

headcircum: head circumference
sw floor: side-waist-to-floor

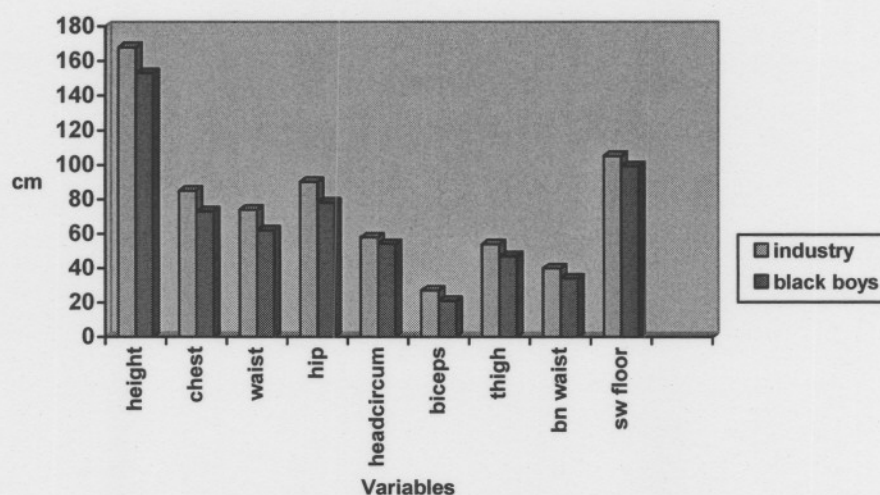
Figure 18: Practically significant differences between the body measurements of 13 year old black boys and those of the industry

Most of the differences between the mean measurements of the thirteen year old black boys and those of the industry, shown in Table 4.4 and Figure 18, are statistically and practically significant. The biceps ($d=2.99$) and the back-nape-to-waist ($d=2.30$) differ the most. The measurements of the thirteen year old boys of the North-West Province, demonstrate no strong variations. Twelve of the thirteen variables, which is almost 92% of the measurements, indicate that there is a statistically significant difference ($p \leq 0.05$) between the two sets of measurements. The variables are height, chest, waist, waist-to-hip, hip, head circumference, neck-base, biceps, thigh, back-nape-to-waist, side-waist-to-floor and inside-leg-to-floor. A practically significant difference was also found between the measurements of the black boys and those of the industry for the ten variables depicted in Figure 18. The hypothesis that the measurements of the thirteen year old black boys differ from those of the industry can be accepted for the ten variables depicted in Figure 18.

4.2.5 Fourteen year old boys

TABLE 4.5 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 14 YEAR OLD BLACK BOYS AND INDUSTRY (N = 45)

Variables	Industry (cm)	Black boys (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance %
1. Height	168.00	153.00	15.00	9.50	10.60	<.0001	1.58	6.21
2. Chest	85.00	72.78	12.22	6.60	12.42	<.0001	1.85	9.07
3. Waist	74.00	62.28	11.72	6.82	11.53	<.0001	1.72	10.95
4. Waist-to-hip	20.00	19.77	0.23	24.55	0.06	0.9495	—	124.21
5. Hip	90.00	78.26	11.74	7.13	11.06	<.0001	1.65	9.11
6. Shoulder	12.00	12.44	0.44	3.58	0.83	0.4099	—	28.80
7. Head circumference	58.00	53.80	4.20	1.73	15.72	<.0001	2.43	3.22
8. Neck-base	36.60	37.12	-1.12	2.30	3.27	0.0021	0.49	6.11
9. Biceps	27.00	21.13	5.87	1.84	21.43	<.0001	3.19	8.69
10. Thigh	54.00	47.36	6.64	5.65	7.89	<.0001	1.18	11.93
11. Back-nape-to-waist	40.00	33.94	6.06	3.10	13.09	<.0001	1.95	9.14
12. Side-waist-to-floor	105.00	98.86	6.14	4.68	8.80	<.0001	1.31	4.74
13. Inside-leg-to-floor	79.00	75.71	3.29	9.17	2.41	0.0204	—	12.11



headcircum: head circumference
sw floor: side-waist-to-floor

bn waist: back-nape-to-waist

Figure 19: Practically significant differences between the body measurements of 14 year old black boys and those of the industry

In Table 4.5 and Figure 19 the mean differences between the measurements used by the industry and those of the sample are portrayed. The biggest difference between the two groups was found in the biceps ($d=3.19$), the head circumference ($d=2.43$) and the back-nape-to-waist ($d=1.95$). There is a very high variation (124.21%) in the waist-to-hip measurement for this age group. Eleven of the thirteen variables, which is almost 85%, show that there is a great statistically significant difference ($p \leq 0.05$) between the two sets of measurements. The variables are height, chest, waist, hip, head circumference, neck-base, biceps, thigh, back-nape-to-waist, side-waist-to-floor and inside-leg-to-floor. Nine variables also show a d -value which is larger than 0.8 indicating a practically significant difference. The hypothesis that the measurements of the fourteen year old black boys differ from those of the industry can be accepted for the nine variables depicted in figure 19.

4.2.6 Synopsis of the boys' results

4.2.6.1 Measurements taken in general

From Table 4.1-4.5 and Figures 15-19 it is evident that there is a significant difference between most of the body measurements of black adolescent boys and those used by the industry. Various girth and length measurements were obtained. Nine (69%) of the thirteen measurements in total taken from the black boys of all age groups were smaller than those used by the industry.

Seven of the total measurements taken from these 10-14 year old black boys were girth measurements. Six of these girth measurements were statistically and practically significantly smaller than those used by the industry, namely chest, waist, hip, head circumference, biceps and thigh. Only one girth measurement, namely the neck-base measurement, was statistically, but not practically significantly bigger than the measurements used by the industry.

Of the six length measurements taken from all the black boys, only three were statistically as well as practically significantly smaller than those used by the industry, namely height, back-nape-to-waist and side-waist-to-floor. The shoulder length for all age groups showed no difference from that used by the industry. The inside-leg-to-floor measurement was the only measurement which showed a statistically, but not a practically significant difference from that used by the industry. This measurement was slightly longer than that used by the industry. The waist-to-hip measurement of the black boys was statistically and practically significantly smaller than that used by the industry for only two of the age groups.

Regarding the size of the differences, the biggest differences between measurements used by the industry and those of the black boys were found for the biceps and back-nape-to-waist measurements for all age groups. These measurements of the boys were smaller than those used by the industry.

The high variations of the waist-to-hip measurements for 11, 12 and 14 year old black boys may be partially due to the fact that there were exceptionally bigger

children in some of the age groups and that the sample of the boys was taken from all over the province, which includes many rural places where the children have to walk long distances to school and some children from informal settlements may be undernourished. The children coming from more affluent communities may be bigger because of better living conditions.

4.2.6.2 Height and chest measurement differences between the industry and black boys

According to Aldrich (1999:14) the basic control measurement for children's clothes is height. Figure 20 illustrates the significant differences in the height measurements between the industry and the black boys of 10 to 14 years old.

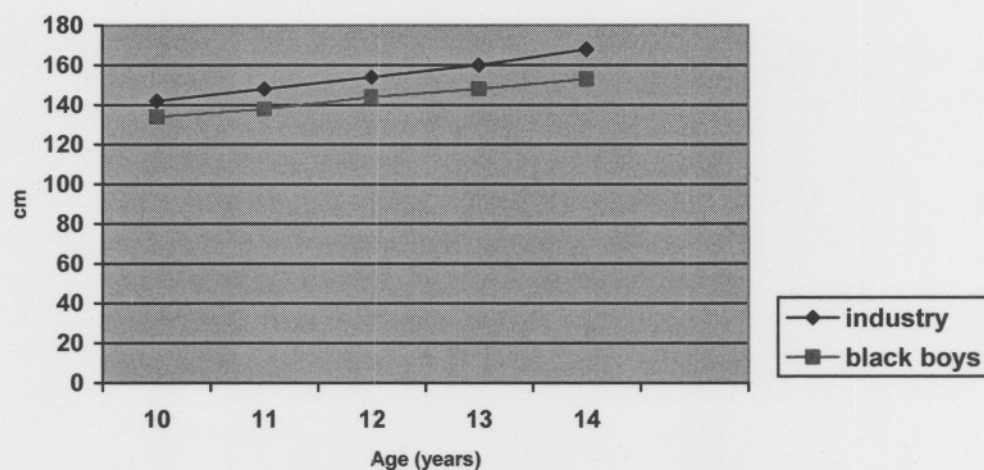


Figure 20: Height measurement differences between the industry and black boys 10 –14 years old

The graph indicates that the industry's height measurements for all the age groups are bigger than those of the black boys. The difference becomes progressively bigger in the older boy's measurements. The fact that the black boys' height measurements fail to match those of the industry can possibly be attributed to external factors, such as nutrition and activity. The stunted height of the black boys,

as shown in the graph, may be caused by the fact that some of the boys in the sample come from disadvantaged families where they can hardly eat a balanced meal. The black boys from poor families are also engaged in hard labour, such as ploughing and cutting wood, which might contribute to their stunted heights.

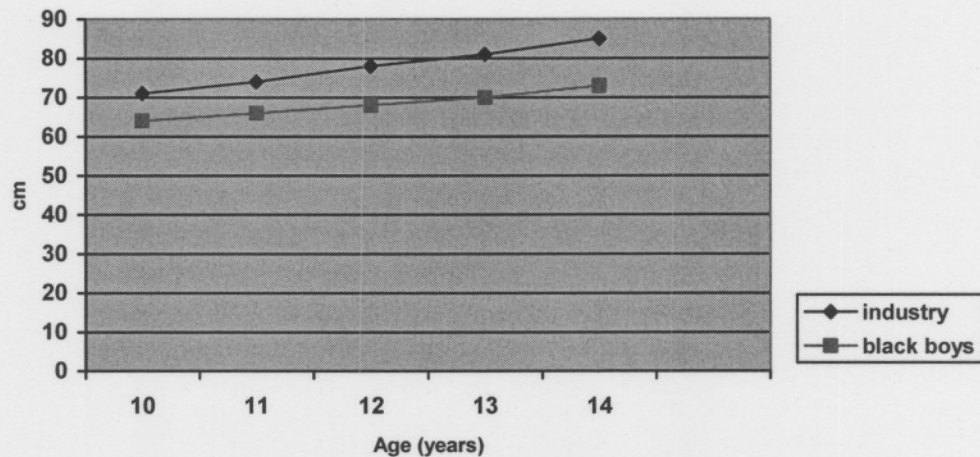


Figure 21: Chest measurement differences between the industry and black boys 10 - 14 years old

Figure 21 illustrates the significant differences in the chest measurements of the industry and the black boys, 10 to 14 years old. The industry's chest measurements for all the age groups are bigger than those of the black boys and the differences become progressively larger with increasing age. The specific chest development of black boys may be attributed to the same factors as those accountable for height measurements.

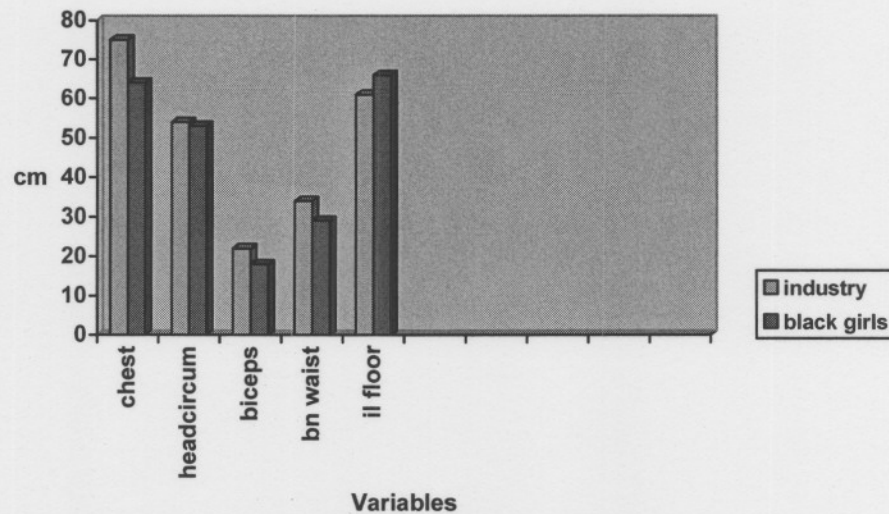
4.3 RESULTS AND DISCUSSION OF THE GIRLS' MEASUREMENTS

As for the boys' results, each measurement table will be followed by a graph which illustrates the practically significant differences between the girls' measurements and the measurements used by the industry. A synopsis of the girls' results will also be given.

4.3.1 Ten year old girls

TABLE 4.6 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 10 YEAR OLD BLACK GIRLS AND INDUSTRY (N =79)

Variables	Industry (cm)	Black girls (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance%
1. Height	140.00	135.51	4.49	8.33	4.76	<.0001	0.54	6.15
2. Chest	75.00	63.96	11.04	6.36	15.42	<.0001	1.73	9.95
3. Waist	61.00	56.33	4.67	6.73	6.17	<.0001	0.69	11.95
4. Waist-to-hip	16.00	16.13	-0.13	2.96	0.40	0.6912	—	18.37
5. Hip	78.00	72.07	5.93	8.53	6.18	<.0001	0.70	11.83
6. Shoulder	10.40	10.93	-0.53	3.13	1.51	0.1361	—	28.64
7. Head circumference	54.00	52.50	1.50	1.46	8.41	<.0001	1.03	2.78
8. Neck-base	33.40	35.00	-1.60	2.83	5.01	<.0001	0.56	8.09
9. Biceps	22.00	18.48	3.52	1.98	15.85	<.0001	1.78	10.69
10. Thigh	46.00	43.59	2.41	6.38	3.35	0.0013	0.38	14.64
11. Back-nape-to-waist	34.00	29.21	4.79	1.88	22.71	<.0001	2.55	6.42
12. Side-waist-to-floor	86.00	86.87	-0.87	5.79	1.33	0.1867	0.15	6.66
13. Inside-leg-to-floor	61.00	66.27	-5.27	4.54	10.31	<.0001	1.16	6.86



headcircum: head circumference

bn waist: back-nape-to-waist

il floor: inside-leg-to-floor

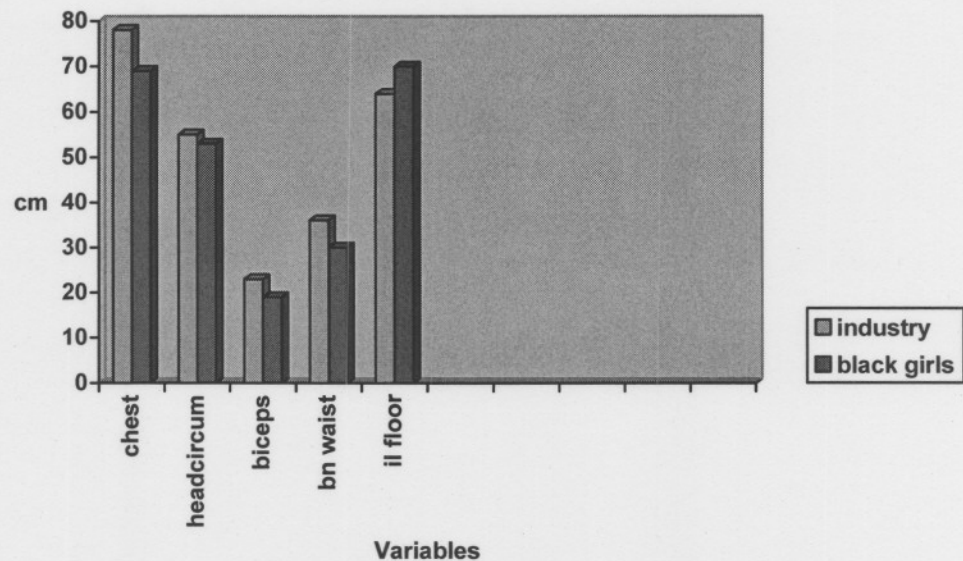
Figure 22: Practically significant differences between the body measurements of 10 year old black girls and those of the industry

From Table 4.6 and Figure 22 it is obvious that the back-nape-to-waist ($d=2.55$), biceps ($d=1.78$) and chest ($d=1.73$) measurements show the biggest differences. The biggest variation (28.64%) in measurements of this age group is shown by the shoulder length. This may be due to the fact that some of the girls in this age group were exceptionally bigger than others. Ten of the thirteen variables (77%) show a statistically significant difference between the measurements of the black girls and those of the industry. The variables are height, chest, waist, hip, head circumference, neck base, biceps, thigh, back-nape-to-waist, and inside-leg-to-floor. Only the five variables depicted in Figure 22 illustrate a practically significant difference between measurements of the industry and those of the ten year old girls. These variables are chest, head circumference, biceps, back-nape-to-waist, and inside-leg-to-floor measurements. The d -value of the other five is less than 0.8, which is not of practical significance. The ten year old girls' inside-leg-to-floor measurement is statistically as well as practically bigger than that of the industry while the chest, head circumference, biceps and the back-nape-to-waist are smaller than those used by the industry. The hypothesis that the measurements of the ten year old girls differ from those of industry can be accepted in case of the above mentioned five variables, which are depicted in Figure 22.

4.3.2 Eleven year old girls

TABLE 4.7 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 11 YEAR OLD BLACK GIRLS AND INDUSTRY (N = 71)

Variables	Industry (cm)	Black girls (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance%
1. Height	146.00	141.34	4.66	6.51	6.04	<.0001	0.72	4.60
2. Chest	78.00	68.66	9.34	8.05	9.78	<.0001	1.16	11.72
3. Waist	62.5	59.14	2.76	8.52	2.71	0.0085	—	14.26
4. Waist-to-hip	17.00	16.27	0.73	2.36	2.59	0.0117	—	14.51
5. Hip	81.00	76.96	4.04	8.64	3.94	0.0002	0.47	11.23
6. Shoulder	10.7	10.99	-0.29	1.10	2.25	0.0276	—	9.98
7. Head circumference	55	53.29	1.71	1.89	6.84	<.0001	0.91	3.55
8. Neck-base	34.2	36.33	-2.13	2.91	6.16	<.0001	0.73	8.02
9. Biceps	23	19.43	3.57	2.46	12.14	<.0001	1.45	12.66
10. Thigh	48	46.73	1.27	5.84	1.84	0.0704	—	12.51
11. Back-nape-to-waist	35.5	30.39	5.11	2.37	18.17	<.0001	2.16	7.79
12. Side-waist-to-floor	90.00	91.97	-1.97	5.23	3.18	0.0022	—	5.69
13. Inside-leg-to-floor	64.00	70.40	-6.40	4.69	11.50	<.0001	1.37	6.66



headcircum: head circumference
il floor: inside-leg-to-floor

bn waist: back-nape-to-waist

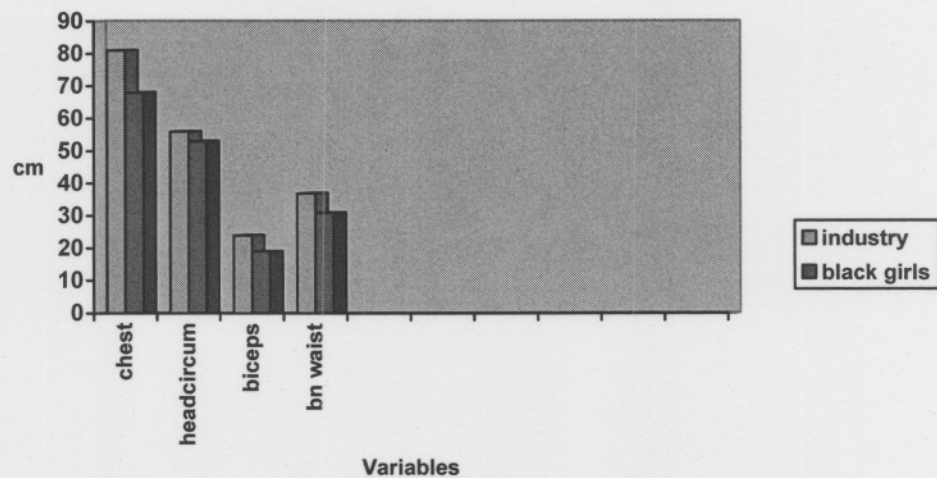
Figure 23: Practically significant differences between the body measurements of 11 year old black girls and those of the industry

According to Table 4.7 and Figure 23 it is clear that for the eleven year old girls, the variables with the biggest differences between measurements of the industry and those of the black girls are back-nape-to-waist ($d=2.16$) and the biceps ($d=1.45$). Although the two sets of measurements differ from each other in that the measurements of the black girls are smaller than those of the industry for most of the variables, the inside-leg-to-floor measurement of the girls is bigger than that of the industry. The biggest variations in the black girls' measurements occur in the waist-to-hip (14.51%) and the waist (14.26%) measurements. Twelve of the thirteen variables (92%) show a statistically significant difference between the industry's measurements and the measurements of the black girls for this age group. The variables are height, chest, waist, waist-to-hip, hip, shoulder, head circumference, neck base, biceps, back-nape-to-waist, side-waist-to-floor and inside-leg-to-floor. Only five of the thirteen measurements, about 38%, show a practically significant difference between the two sets of data with d -values larger than 0.8. These variables are the chest, head circumference, biceps, back-nape-to-waist and inside-leg-to-floor. The hypothesis that the measurements of the eleven year old girls differ from those of industry can be accepted for the five variables depicted in Figure 23.

4.3.3 Twelve year old girls

TABLE 4.8 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 12 YEAR OLD BLACK GIRLS AND INDUSTRY (N = 150)

Variables	Industry (cm)	Black girls (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance%
1. Height	152.00	145.57	6.43	8.63	9.14	<.0001	0.75	5.93
2. Chest	81.00	68.31	12.69	11.67	13.32	<.0001	1.09	17.09
3. Waist	64.00	60.02	3.98	6.24	7.81	<.0001	0.64	10.39
4. Waist-to-hip	18.00	17.31	0.69	2.80	3.03	0.0029	—	16.20
5. Hip	84.00	78.77	5.23	8.35	7.67	<.0001	0.63	10.60
6. Shoulder	11.00	11.39	-0.39	1.52	3.18	0.0018	—	13.30
7. Head circumference	56.00	53.15	2.85	1.89	17.46	<.0001	1.51	3.56
8. Neck-base	35.00	36.78	-1.78	2.85	7.63	<.0001	0.62	7.75
9. Biceps	24.00	19.74	4.26	1.97	26.51	<.0001	2.16	9.98
10. Thigh	50.00	46.53	3.47	6.38	6.67	<.0001	0.54	13.72
11. Back-nape-to- waist	37.00	31.46	5.54	2.35	28.93	<.0001	2.36	7.46
12.Side-waist-to- floor	95.00	94.62	0.38	6.26	0.74	0.4580	—	6.61
13. Inside-leg-to- floor	68.00	72.65	-4.65	6.16	9.23	<.0001	0.75	8.48



headcircum: head circumference

bn waist: back-nape-to-waist

Figure 24: Practically significant differences between the body measurements of 12 year old black girls and those of the industry

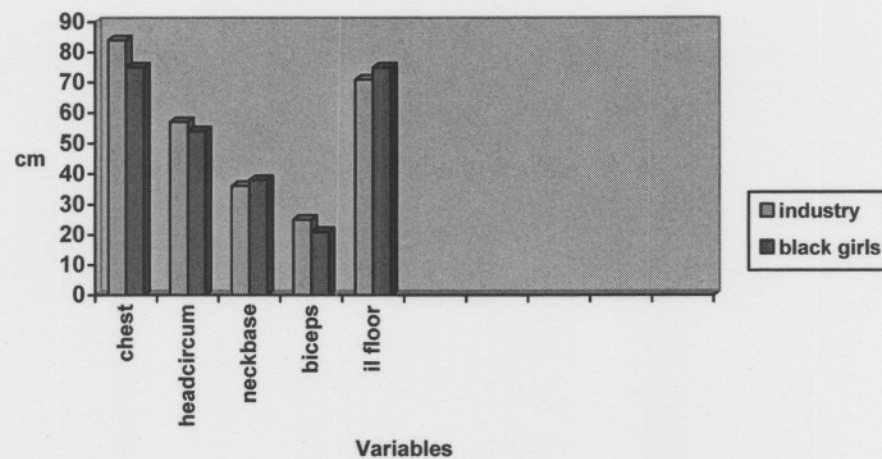
From Table 4.8 and Figure 24, it is evident that the mean measurements of the twelve year old black girls and that of the industry also show some significant differences. The biggest differences are in the back-nape-to-waist ($d=2.36$) measurement and the biceps ($d=2.16$) measurement. The different measurements of the twelve year old girls show the biggest variation in the chest (17.09%), waist-to-hip (16.20%), thigh (13.72%) and shoulder (13.30%) measurements. Twelve of the thirteen variables (92%) show a statistically significant difference, which is accepted at the level of $p \leq 0,05$. The variables are height, chest, waist, waist-to-hip, hip, shoulder, head circumference, neck base, biceps, thigh, back-nape-to-waist and the inside-leg-to-floor. Nine of the twelve variables for this age group are smaller than the industry's measurements, while three, namely the inside-leg-to-floor, neck-base, and shoulder are bigger than the measurements of the industry.

There are practically significant differences between industry's measurements and the measurements of the twelve year old black girls in four of the variables (31%). The variables are the chest, head circumference, biceps, and back-nape-to-waist, although six more of the measurements have a d -value which indicates a medium practical significance. The hypothesis that the measurements of the industry differ from the measurements of the twelve year old black girls can be accepted for the four variables depicted in Figure 24.

4.3.4 Thirteen year old girls

TABLE 4.9 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 13 YEAR OLD BLACK GIRLS AND INDUSTRY (N = 60)

Variables	Industry (cm)	Black girls (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	coefficient of variance%
1. Height	158.00	149.93	8.07	10.69	5.85	<.0001	0.76	7.13
2. Chest	83.50	75.23	8.27	6.97	9.20	<.0001	1.19	9.26
3. Waist	65.00	62.07	2.93	5.93	3.83	0.0003	0.49	9.55
4. Waist-to-hip	19.00	18.42	0.58	8.01	0.56	0.5748	—	43.49
5. Hip	87.50	81.83	5.67	11.77	3.73	0.0004	0.48	14.39
6. Shoulder	11.30	11.81	-0.52	1.00	3.92	0.0002	0.51	8.51
7. Head circumference	57.00	53.53	3.47	1.63	14.92	<0001	2.13	3.04
8. Neck-base	35.80	37.89	-2.09	2.61	6.20	<0001	0.80	6.89
9. Biceps	25.00	20.77	4.23	1.72	19.07	<0001	2.46	8.28
10. Thigh	52.00	49.88	2.13	5.48	3.00	0.0039	—	11.00
11. Back-nape-to-waist	38.50	34.83	3.67	13.05	2.18	0.0336	—	37.47
12. Side-waist-to-floor	98.50	97.88	0.62	5.13	0.93	0.3560	0.12	5.25
13. Inside-leg-to-floor	70.50	75.23	-4.72	4.53	8.08	<.0001	1.04	6.02



headcircum: head circumference

il floor: inside-leg-to-floor

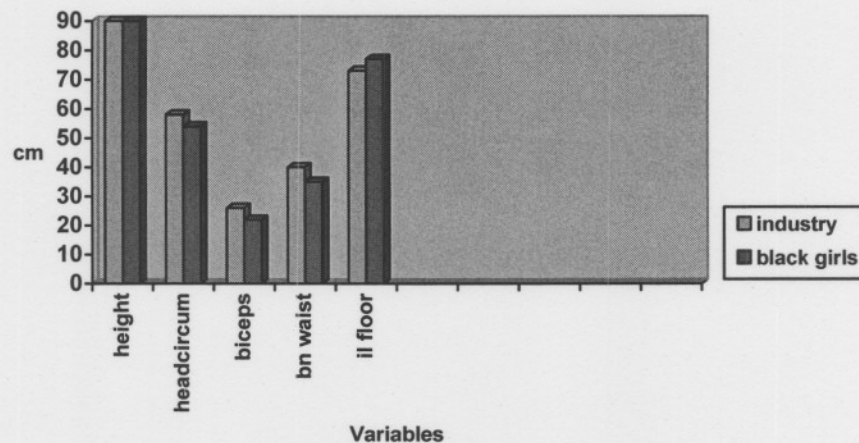
Figure 25: Practically significant differences between the body measurements of 13 year old black girls and those of the industry

In Table 4.9 and Figure 25 the biggest differences in the measurements between the thirteen year old black girls and the industry are in the biceps ($d=2.46$) and head circumference ($d=2.13$). The biggest variation in measurement for this age group is found at the waist-to-hip measurement (43.49%), followed by the back-nape-to-waist measurement (37.47%). According to Aldrich (1999:6), girls begin to grow quickly at about the age of eleven or twelve and she notes that a proportion of eleven to thirteen year old girls are taller than boys of the same age. Although the speed at which a boy and a girl grow is similar until puberty, the average girl is slightly shorter than the average boy and slightly heavier. Eleven, which is about 85% of the thirteen variables, show that there is also a statistically significant difference between the industry's measurements and the measurements of the thirteen year old girls ($p \leq 0.05$). The variables are the height, chest, waist, hip, shoulder, head circumference, neck-base, biceps, thigh, back-nape-to-waist and inside-leg-to-floor. A practically significant difference is illustrated by five of these variables (38%), namely, the chest, head circumference, neck-base, biceps and inside-leg-floor measurements. The hypothesis that the measurements of the thirteen year old black girls and those of industry are different can be accepted for the five variables depicted in Figure 25.

4.3.5 Fourteen year old girls

TABLE 4.10 DIFFERENCES BETWEEN BODY MEASUREMENTS: THE 14 YEAR OLD BLACK GIRLS AND INDUSTRY (N = 65)

Variables	Industry (cm)	Black girls (cm)	Mean difference (cm)	Standard deviation	t-value	p-value	d-value	Coefficient of variance%
1. Height	164.00	154.04	9.96	6.25	12.84	<.0001	1.59	14.06
2. Chest	86.00	80.62	5.38	9.56	4.54	<.0001	0.56	11.86
3. Waist	66.00	65.23	0.77	10.08	0.61	0.5415	—	15.46
4. Waist-to-hip	20.00	20.87	-0.87	12.25	0.57	0.5692	—	58.69
5. Hip	91.00	87.75	6.75	13.69	3.98	0.0002	0.49	15.60
6. Shoulder	11.60	12.07	-0.47	1.31	2.89	0.0053	—	10.86
7. Head circumference	58.00	54.23	3.77	1.81	16.14	<.0001	2.08	3.34
8. Neck-base	36.60	39.46	-2.86	7.54	3.06	0.0032	—	19.11
9. Biceps	26.00	21.63	4.37	2.25	15.70	<.0001	1.95	10.39
10.Thigh	54.00	54.21	-0.21	7.40	0.23	0.8216	—	13.65
11.Back-nape-to-waist	40.00	34.64	5.36	2.57	16.85	<.0001	2.09	7.41
12.Side-waist-to-floor	102.00	100.35	1.65	5.05	2.64	0.0104	—	5.03
13.Inside-leg-to-floor	73.00	77.48	-4.48	4.43	8.16	<.0001	1.01	5.72



headcircum: head circumference

il floor: inside-leg-to-floor

bn waist: back-nape-to-waist

Figure 26: Practically significant differences between the body measurements of 14 year old black girls and those of the industry

According to Table 4.10 and Figure 26, the biggest statistically significant differences between the measurements of the fourteen year old black girls and the industry are in the back-nape-to-waist ($d=2.09$), the head circumference ($d=2.08$) and the biceps ($d=1.95$). The waist-to-hip measurements of the fourteen year old black girls show a very high variation (58.69%). It may be due to the fact that there were exceptionally bigger children in this age group. Black children in South Africa, whose parents move up the socio-economic ladder and earn higher incomes, often reach higher heights and weights once they are provided with more and healthier food. There is a statistically significant difference between the industry's measurements and those of the fourteen year old black girls of the North-West Province at ($p \leq 0,05$). It is illustrated by ten (77%) of the thirteen variables. The variables are the height, chest, hip, shoulder, head circumference, neck base, biceps, back-nape-to-waist, side-waist-to-floor and inside-leg-to-floor. Only five (38%) of these ten measurements are practically significantly different. The variables are the height, head circumference, biceps, back-nape-to-waist and the inside-leg-to-floor. The height, head circumference, biceps and back-nape-to-waist measurements are practically smaller than those used by the industry, while the inside-leg-floor is bigger. The chest measurement however, also being smaller,

shows a medium practically significant difference with a d-value of 0.5 and therefore can be ignored. The hypothesis that the measurements of the fourteen year old girls and those of industry are different can be accepted for the five variables depicted in Figure 26.

4.3.6. Synopsis of the girls' results

4.3.6.1 Measurements taken in general

From the girls' results (Tables 4.6 - 4.10 and Figures 23-27) it is clear that there is a significant difference between the body measurement of the 10 to 14 year old girls of the North-West Province and those of the industry. Various girth and length measurements were obtained.

Seven of the total measurements taken from the black girls were girth measurements. Two of these girth measurements, namely the head circumference and the biceps, were statistically and practically significantly smaller than those used by the industry. The other girth measurement worth mentioning is the chest measurement, which is statistically as well as practically significantly smaller than the measurements used by the industry for four of the age groups. For two of the age groups there were no statistical or practical differences in the thigh measurements.

Of the six length measurements taken from all the black girls only one, namely the height, was statistically as well as practically significantly smaller than that used by the industry. Two other length measurements namely back-nape-to-waist and inside-leg-to-floor were statistically and practically significantly smaller than those used by the industry for four of the various age groups. For three of the groups, two of the length measurements namely the waist-to-hip and side-waist-to-floor showed no statistically or practically significant differences from those used by the industry.

Differences between measurements of the black girls and those used by the industry were most prominent for the back-nape-to-waist and the biceps measurements for all age groups except for the thirteen year old girls, where the

biggest differences were encountered in the biceps and head circumference measurements.

The high variation in the waist-to-hip measurements for the thirteen and fourteen year old black girls may be due to the differing growth patterns of individual girls, in which nutrition and activity may play a role. Aldrich (1999:8) notes that a proportion of eleven to thirteen year old girls are growing faster than boys of the same age and that the girls' hip size shows a particular increase. This may also be true for the eleven to thirteen year old black girls and boys of the North-West Province, as the girls' measurements for all the variables of the eleven, twelve and thirteen year age groups are bigger than those of the boys.

4.3.6.2 Waist and height measurement differences between the industry and black girls

Figure 27 illustrates the significant differences of the waist measurements between the industry and the black girls' measurements for all the age groups.

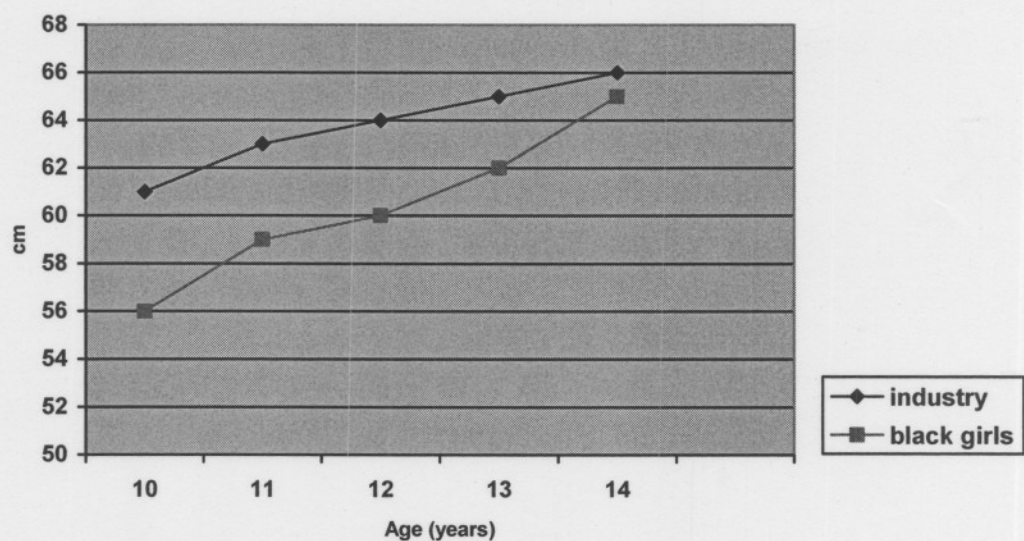


Figure 27: Waist measurement differences between the industry and black girls 10 – 14 years old

From this graph, it is clear that the industry's waist measurements are bigger than

those of the black girls for all the age groups. The difference is very big for the ten to thirteen year olds and becomes smaller at the age of fourteen years. These differences may be attributed to external factors such as nutrition and activity. Some of the girls in the study come from disadvantaged families where they can hardly eat balanced meals and therefore, they are underweight. Some of the black girls in the sample have to walk long distances to school and work hard due to poverty and lack of resources, which may also result in weight reduction.

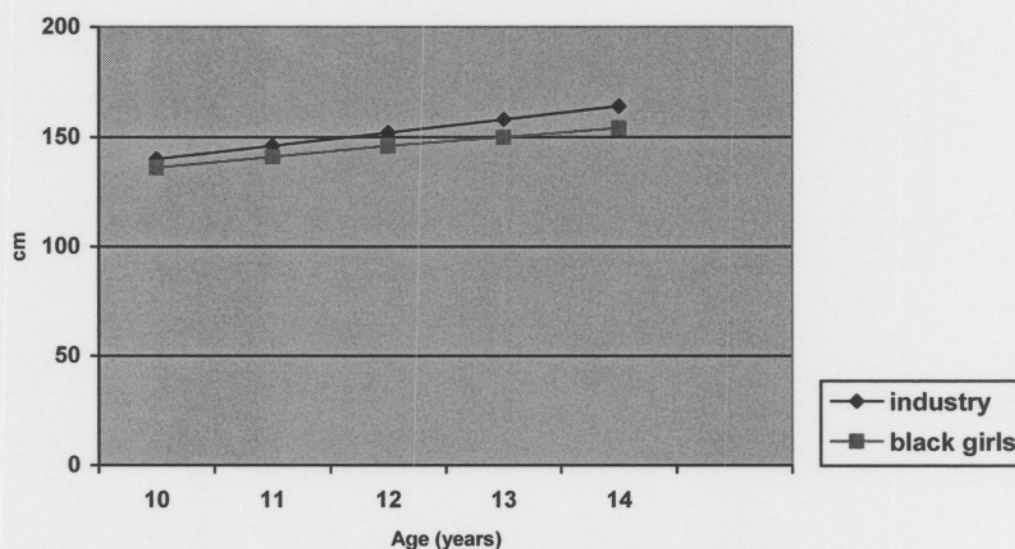


Figure 28: Height measurement differences between the industry and black girls 10 – 14 years old

Figure 28 illustrates the differences in height between the industry and the black girls of all ages. These differences are all statistically significant and display d-values of 0.7, except for the ten year old girls ($d=0.54$), which gives evidence of moderate practical significance.

The height measurements of the black girls are smaller than the height measurements which are used by the industry. The external factors (nutrition and activity) discussed in the previous graph might also contribute to these differences. Brown and Rice (1998:152) note that growth speeds up as children approach puberty.

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS, IMPLICATIONS FOR INDUSTRY, RECOMMENDATIONS AND FINAL REMARKS

5.1 SUMMARY

The aim of the survey was to determine whether the body measurements of the children aged between 10 and 14 years of the North-West Province differ from the body measurements used by the industry. Relevant literature was studied (chapter 2) which served as basis for the empirical study. A suitable methodology (chapter 3) was used on which scientific findings were based and valid conclusions were drawn (chapter 4 and 5).

It is a known fact that until recently the South African clothing industry had not based their sizing systems on any relevant research. Most of South African sizing is based on Western proportions (see problem statement, paragraph 1.2).

South African children's body shapes are said to be more athletic than their European and Australian counterparts. European children are said to be flabbier than the South African rural as well as urban children with their outdoor lifestyle.

Sizing is considered a complex issue as it deals with a great amount of variability, fluctuating body dimensions between individual populations and generations, differences in collecting and processing anthropometric data, and variations in analyzing and interpreting the data into sizing systems. Fit testing is considered to deal with an even greater amount of variability.

The ultimate usefulness of any anthropometric survey depends completely on the extent to which the total body of derived data can be transformed by statistical analysis into summaries or charts which can be used for solving fit problems.

Anthropometric surveys can result in garments that fit more people better. Waste can be reduced considerably. Sizes that do not fit anyone are eliminated and it is

easier to determine what sizes people wear and how many of each size to make and stock.

The results of this survey can serve as a basis for size charts suitable for children's clothing between 10 and 14 years old. The highly significant difference between some of the body measurements of the black adolescent children of the North West Province and the body measurements used in the production of children's clothes reveals a need to follow up this study with a more extensive survey in order to confirm that measurements used by the industry will not be suitable for children of all population groups.

5.2 CONCLUSIONS

From the results obtained in this study, the following conclusions can be drawn in accordance with the objectives and hypotheses.

Nine (69%) of the thirteen measurements taken from the black boys of all age groups differed statistically and practically significantly from the measurements used by the South African industry in the production of children's clothes, namely height, chest, waist, hip, head circumference, biceps, thigh, back-nape-to-waist and side-waist-to-floor.

Almost three quarters of the boys' measurements were smaller than those used by the South African industry. The neck-base measurements for all the age groups of the boys were only statistically bigger than those used by the industry. No practical or statistical differences were shown between the shoulder measurements of the black boys aged 10-14 years and those used by the industry. The hypothesis that there is a significant difference between the measurements of the black boys of North-West Province and the South African industry can be accepted for the height – chest -, waist-, hip -, head circumference -, biceps -, thigh -, back-nape-to-waist – and side-waist- to-floor measurements.

Two of the thirteen measurements taken from the black girls of all age groups in the North-West Province, namely the biceps and head circumference, were statistically

significantly smaller than the measurements used by the South African industry. The neck-base measurements of all the age groups of the black girls were statistically larger than the measurements of the industry. For each of the age groups, four to five of the measurements differed statistically as well as practically significantly. The hypothesis that there is a significant difference between the measurements of black girls aged 10-14 years and the measurements used by the industry can be accepted for these measurements.

To conclude, a more definite pattern (for each of the measurements taken, the boys' measurements was smaller, while for the girls' only a few was smaller) could be detected in differences between black boys' measurements and those used by the industry, than between black girls' measurements and those used by the industry.

5.3 IMPLICATIONS FOR INDUSTRY

- ◆ More manufacturers and designers of clothes should adjust their sizes to accommodate the black child in our country.
- ◆ Manufacturers and designers should take note of the fact that big variations occur in some age groups and in some measurements.
- ◆ The significant differences in the biceps and back-nape-to-waist measurements, which exist between the black boys' measurements and those of the industry, should be taken into consideration for adjusting the sizes of the boys between the ages 10 to 14 years for industrial use.
- ◆ The size charts can be developed for various purposes such as the construction and grading of patterns for garments, manufacturing specifications and retail.

5.4 RECOMMENDATIONS

- ◆ Although research is being done, more should be done to include all provinces and all ethnic groups. A comprehensive national survey across all age groups and sizes is required. This can be a study field for further investigation by academics in collaboration with the industry.
- ◆ Measurement charts also need to be revised at least every ten years because of changes in lifestyle, dietary habits and physical activities.

- ◆ For further research the body measurements of the different population groups e.g. black children versus white children can be compared to see if, and how big the differences are.

5.5 FINAL REMARKS

From the literature and own experience it is clear that this kind of surveys are very time consuming and it will take considerable funding and several years to update all body measurement tables.

Another factor that will have an impact on the local clothing manufacturers, is the need to have sizing standards in place in order to compete globally. Foreign companies looking to open factories in South Africa have this data at their fingertips and could challenge the competitive advantage enjoyed by local operations to benefit from internal trade.

Another possible solution to the sizing dilemma lies in labelling clothing with the body measurements the garment is designed to fit. Size labelling expressed in terms of body measurements gives useful information to consumers. Mail-order retailers use it and some other retailers and manufacturers concerned with maintaining a quality reputation for providing good fit, use this system. Informative size labels which relate to body measurements help companies to satisfy the fit needs of consumers.

An anthropometric size description system would reduce the return rate caused by consumers purchasing the incorrect size and would also reduce damaged merchandise caused by frequent trying on of garments. Thus it would likely contribute to great profits for both manufactures and retailers.

It is recommended therefore, that the South African clothing industry should use new measuring size charts, which will assist in meeting the sizing and fitting needs of all South Africans.

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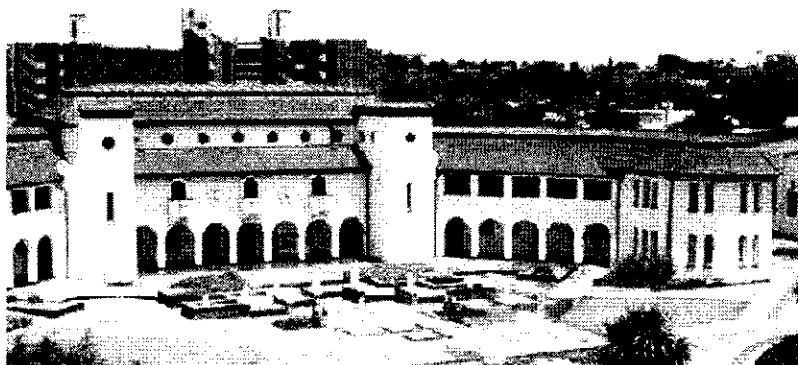
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APPENDIX A

FRAMEWORK OF THUSABANA PROJECT

**THUSA BANA PROJECT
INFORMATION**



PU FOR CHE

**¹SCHOOL OF PHYSIOLOGY, NUTRITION AND
FAMILY ECOLOGY**

²SCHOOL FOR BIOKINETICS, AND SPORT SCIENCE

**PROF. HH VORSTER (DIRECTOR)¹
DR. JH DE RIDDER (DIRECTOR)²**



Potchefstroomse Universiteit
vir Christelike Hoër Onderwys

THUSA BANA PROJECT: INFORMATION ON THE STUDY

**THE PROJECT HAS BEEN APPROVED BY THE ETHICS COMMITTEE OF THE PU FOR CHE.
ETHICS COMMITTEE NUMBER (00M10)**

I CONFIRM THAT:

It has been explained to me, that:

1. The purpose of the research study is to collect information on the problem of overweight and obesity among schoolchildren aged 10-15 years in the North West Province of South Africa.
2. I have been told that the researchers will obtain anthropometric variables of a random sample of children aged 10-15 years
3. The participant will be weighed and his/her height as well as circumferences and skinfolds of his/her arm will be measured without causing any pain to the child. For those measurements boys and girls in separate groups will be asked to undress in privacy of a class-room, because some measurements must be taken with the children dressed in underwear only. The different age groups will be measured separately. The researchers and fieldworkers will work in a professional way, not to embarrass the children.
4. Appropriate methodology to classify overweight and obesity in these age groups will be developed
5. The prevalence of obesity in children in the North West Province will be determined
6. The anthropometry of the different ethnic groups will be compared
7. The relationship between body mass index and adiposity in stunted children (low-height-for-age) will be determined
8. The role of dietary practices in the development of overweight and obesity will be determined
9. The role of physical activity levels and patterns in the development of obesity
10. Influences of ethnicity and urbanisation on the causative factors of overweight and obesity will be determined
11. Perceptions regarding overweight and obesity in these age groups will be measured
12. The general health status of obese children with controls, regarding absence from school due to illness will be compared
13. Guidelines for appropriate, culture sensitive, practical and sustainable intervention programmes for these age groups will be developed
14. I have also been told that this research is being done for the benefit of the children, and that 1200 children will take part in this study
15. It was also explained to me that the information I will give shall be kept confidential, but that it will be used anonymously for making known the findings to other scientist
16. It was also clearly explained to me that I can refuse to participate in this research study or I can stop answering the questions at any time during the interview

The information in this consent form was explained to me by _____ (name of interviewer) in _____ (language) and I confirm that I have a good command in this language and understood the explanations, OR it was translated to me by _____ (Name of translator) in my language _____. I was also given the opportunity to ask questions on things I did not understand clearly.

I the participant (child) hereby agree voluntarily to take part in this research survey.

Signed/confirmed at _____ on _____ 2000

Witness _____

Participant's/representative of participant (parent) _____

APPENDIX B

INDUSTRY MEASUREMENT CHARTS FOR BOYS AND GIRLS

OLDER GIRLS BODY MEASUREMENT CHART

SIZE – AGE	9	10	11	12	13	14
1. HEIGHT	134	140	146	152	158	164
2. CHEST	71	75	78	81	83.5	86
3. WAIST	60	61	62.5	64	65	66
4. WAIST TO HIP	15	16	17	18	19	20
5. HIP	75	78	81	84	87.5	91
6. SHOULDER LENGTH	10.1	10.4	10.7	11	11.3	11.6
7. HEAD CIRCUMFERENCE	53	54	55	56	57	58
8. NECK BASE CIRCUMFERENCE	32.6	33.4	34.2	35	35.8	36.6
9. UPPER ARM CIRCUMFERENCE	21	22	23	24	25	26
10. THIGH	44	46	48	50	52	54
11. NAPE TO WAIST – CENTRE BACK	32	34	35.5	37	38.5	40
12. SIDE-WAIST TO FLOOR	83	66	90	95	98.5	102
13. INSIDE LEG – CROTCH TO FLOOR	59	61	64	68	70.5	73

OLDER BOYS BODY MEASUREMENT CHART

SIZE – AGE	9	10	11	12	13	14
1. HEIGHT	136	142	148	154	160	168
2. CHEST	69	71	74	78	81	85
3. WAIST	62	63	65	68	71	74
4. WAIST TO HIP	16	17	18	19	20	20
5. HIP	73	76	89	82	86	90
6. SHOULDER LENGTH	10	10.5	10.8	11	11.5	12
7. HEAD CIRCUMFERENCE	53	54	55	56	57	58
8. NECK BASE CIRCUMFERENCE	32.6	33.4	34.2	35	35.8	36.6
9. UPPER ARM CIRCUMFERENCE	22	23	24	25	26	27
10. THIGH	44	46	48	50	52	54
11. NAPE TO WAIST – CENTRE BACK	32	34	36	38	39	40
12. SIDE-WAIST TO FLOOR	87	91	94	97	101	105
13. INSIDE LEG – CROTCH TO FLOOR	66	69	71	73	76	79

APPENDIX C

ANTHROPOMETRIC MEASUREMENT DATA CHART (CLOTHING)

NAME

SAMPLE NO

GENDER M ☐ F ☐

SCHOOL

AGE

DATE OF BIRTH

Year		Month		Day	

TEST DATE

Year		Month		Day	

MEASUREMENTS: CIRCUMFERENCE

- | | | | | | |
|----|-----------|----------------------|----------------------|----------------------|----------------------|
| 1. | Neck-base | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 2. | Head | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 3. | Upper arm | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 4. | Chest | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 5. | Waist | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 6. | Hip | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 7. | Thigh | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

LENGTH

- | | | | | | |
|-----|----------------|----------------------|----------------------|----------------------|----------------------|
| 8. | Shoulder | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 9. | Nape-to-waist | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 10. | Waist-to-hip | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 11. | Waist-to-floor | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 12. | Inside leg | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 13. | Height | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |